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EQUITY OF THE SHARE LEASE USED AMONG RICE FARMERS IN CALAMBA, LAGUNA [1]

F. M. SACAY AND E. P. AGUSTIN
Of the Departments of Agricultural Education and Agricultural Economics

A share lease is generally considered equitable if it allows a share of the crop that is proportionate to the share in the expenses of production. The legal basis for the division of crop production and expenses between the tenant and the landlord in the Philippines is the Rice Share Tenancy Act, No. 4054 passed in 1933. This act was later amended by Commonwealth Act No. 178 and Republic Act No. 34. The original act states that in the absence of a written contract to the contrary, the tenant will receive 50 per cent of the crop if he owns the work animals and farm implements and if he shoulders half of the expenses of planting and cultivation. The act, as amended, allows the tenant 70 per cent if he bears all the expenses and 75 per cent if the normal production is less than 40 cavans of palay for every cavan of seeds. It also provides that in a 50-50 crop division, the landlord furnishes the necessary work animals and farm implements and bears half of the expenses of planting and cultivation.

The Bell Economic Survey Mission to the Philippines recommended the enforcement of a law providing for a 70-30 per cent division of the crop between the tenant and the landlord. In view of the importance of the problem of giving a fair share to about 70 per cent of tenant farmers, or 35 per cent of all farm operators in this country, more information on the subject was secured.

One hundred irrigated rice farms, operated under a 50-50 share lease, were surveyed in Calamba, Laguna. These farms produced two crops of rice a year. The dry-season crop, transplanted in November and December, 1948, and the wet-season crop, transplanted in May and June, 1949, were covered by this investigation.

FINDINGS AND DISCUSSION

Division of expenses and production

The average production expenses for a farm and for a hectare are shown in table 1. With few exceptions, the tenant and the landlord shared equally in the cost of seeds and fertilizer and in the expenses for planting, harvesting, and threshing. In addition, the tenant spent ₱183.57 for personal labor, ₱23.59 for family labor,

[1] Experiment Station Contribution No. 1607. Read before the Los Baños Biological Club on August 31, 1951.

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₱97.65 for animal labor, and ₱13.82 for the use of implements. The landlord, on the other hand, spent ₱196.80 for the interest on investment in land, ₱4.83 for land tax, and ₱4.00 for irrigation charges. The total expenses of production of two crops amounted to ₱753.55 a hectare.

The two crops yielded a total of 102 cavans to a hectare. After deducting the share of the harvesters, the net production was 87.2 cavans a hectare. Since the average area of a farm was 1.6502 hectares, the net production of each farm was 144 cavans, or 72 cavans each for the tenant and the landlord.

Equity of the 50-50 share lease

Table 1 also shows the relative share of the tenant and the landlord in the cost of production. The tenant contributed 57.4 per cent, or 7.4 per cent more than what would be generally considered as his fair share of the expenses under the 50-50 crop division. The existing terms seemed to be satisfactory to the tenants in the area, probably because they gave more weight to the amount of rice which they could get from a season's or year's work than to the percentage of the yield. The irrigated farms in Calamba produced higher yield from a hectare than the areas without irrigation facilities.

Based on the percentages given above, the terms of the share lease used in Calamba cannot be concluded as somewhat unfair to the tenant. One should consider that the landlord's contribution is the use of his land, a big item in the cost of production which is very difficult to evaluate accurately. In this survey, the market value of the farm land, as estimated by the tenant-operators, averaged ₱3280 a hectare. Actual sales, however, revealed that a more reasonable value would be about ₱6000 a hectare. The landowners' estimates were close to this figure. At this value, the landlord would be contributing 52.8 per cent of the expenses of production. The above land value is not excessive if we employ income as the basis of farm valuation. After deducting all expenses, the income of the landlord from 43.6 cavans at ₱12 a cavan would be ₱479.62. At 6 per cent returns on investment, the value of land would be ₱7994 a hectare. Any change in the price of palay will naturally result in a corresponding change in land value, as has been the case in Calamba and elsewhere.

Equity of the 50-50 share lease on individual farms

Hester and others [2] and Dalisay,[3] in their surveys of rice tenancies, found that the 50-50 share lease was the most common. Hes-

[2] Hester, Evett D., Pablo N. Mabbun, and others. 1924. Some economic and social aspects of Philippine rice tenancies. Philippine Agriculturist **12**: 267–444.

[3] Dalisay, Amando M. 1937. Types of tenancy contracts on rice farms of Nueva Ecija. Philippine Agriculturist **26**: 159–198.

ter and his co-workers reported that the typical contract between the tenant and the landlord was equitable. Does it follow that terms considered just for a whole group of tenants are also equitable for each individual? Apparently, it is not so, judging from the figures in table 2. The expenses of production borne by the tenants ranged from 40 to 69 per cent. This means that terms considered fair in one case may not be so in another because of variations in conditions, such as topography, type of soil, productivity, investment in land, and intensity of culture. Furthermore, the ratio borne by the tenants working on the same farm may change as land value, interest rate, tax, wage, and price of fertilizer and other materials change.

It was found that in cases where the tenants contributed a high percentage of the cost of production, their figures on man labor were relatively higher and their estimates of land value were relatively lower than the average of all cases included in the survey.

Returns to tenant and landlord

The tenant was primarily interested in the income from his labor and the landlord, in the returns on his investment. The tenant's income from 72 cavans at ₱12.00 a cavan was ₱864.00. When his share of the expenses for seed, fertilizer, and planting, and the use of work animals and implements were deducted, there was a balance or labor income of ₱624.21 for 170.9 days' work, or a labor income of ₱3.65 a day (table 3). This was much higher than the prevailing wage of ₱2.00 a day.

The landlord received ₱479.99 from his share of the crop to the hectare after deducting land tax, irrigation charges, and share of other expenses. This gave him a return of 14.6 per cent on an estimated investment of ₱3280 a hectare, or 8.0 per cent on an investment of ₱6000 a hectare.

Returns under the 55-45 share lease

The Rice Share Tenancy Act provides that when the tenant and the landlord enter into a written contract, it is against public policy to give the tenant less than 55 per cent of the net produce if he furnishes work animals and farm implements and shares equally in the expenses of planting and cultivation. This manner of division appears equitable under conditions obtaining in Calamba if the tenants' estimate of farm value is to be used, for the findings of this study show that the tenant's contribution to the total cost of production is close to this figure (table 1).

Under the 55-45 share lease provided in the Tenancy Act, the tenant's labor income would increase from ₱624.21 to ₱710.61 a farm, or from ₱3.65 to ₱4.16 a day. The rate of returns on the landlord's investment would decrease from 14.6 to 13.0 per cent on an invest-

ment of ₱3280 a hectare, or from 8.0 to 7.1 per cent on an investment of ₱6000 a hectare (table 3).

Returns under the 70-30 share lease

Under the 70-30 share lease, the tenant would receive 70 per cent of the net production, or 100.8 cavans from each farm, valued at ₱1209.60 (table 3). After deducting all expenses of production except land tax, there would remain a balance of ₱905.86, which represents earnings of his labor. This would give him a labor income of ₱5.30 a day, as against ₱3.65 under the 50-50 share lease. On the other hand, the landlord would receive 30 per cent of the net production, or 43.2 cavans a farm, valued at ₱518.40. After deducting land tax, there would be a balance of ₱309.31 a hectare, or 9.4 per cent returns on an investment of ₱3280 a hectare. If land were valued at ₱6000 a hectare, the returns on investment would be reduced to 5.2 per cent, which is slightly lower than the rate charged on properly secured bank loans. The reduced returns to the landowner under the 70-30 share lease would result in the lowering of land value, making it easier for the landless to purchase farms.

The foregoing figures show that the 70-30 share lease would be more advantageous to the tenant. While the tenant would be getting 70 per cent of the net production, he would be contributing only 62.5 per cent of the cost of production when the investment in land is ₱3280 a hectare, or 51.4 per cent when land is valued at ₱6000 a hectare.

SUMMARY AND CONCLUSION

1. As a business partnership between the tenants and the landlords, the existing terms of the 50-50 share lease used among rice farmers in Calamba, Laguna, are almost equitable.

2. Terms which may appear equitable to a whole group of tenants may prove favorable to some and unfavorable to others.

3. Changing the terms of the existing share lease in order to make it more favorable to tenants could be justified not on the ground of partnership equity but as a social measure designed to raise the earnings of the tenant and to bring down land value, thus making it easier for the landless to purchase farms. It is doubtful, however, whether the tenants will have as good a chance of buying farms in the open market as the persons engaged in other occupations or professions have. To increase materially farm ownership among actual farm operators, measures other than mere modification of the terms of the share lease should be adopted.

TABLE 1

Division of expenses of production between tenant and landlord

COST ITEMS	AVERAGE PER FARM [a]			AVERAGE PER HECTARE [a]		
	Tenant	Landlord	Total	Tenant	Landlord	Total
	pesos	*pesos*	*pesos*	*pesos*	*pesos*	*pesos*
Seeds	25.25	25.25	50.50	15.30	15.30	30.60
Fertilizer, spray materials	0.21	0.53	0.74	0.13	0.32	0.45
Irrigation charges	—	6.60	6.60	—	4.00	4.00
Land tax	—	7.97	7.97	—	4.83	4.83
Use of land (6% interest)	—	324.76	324.76	—	196.80	196.80
Use of implements (depreciation and interest)	22.81	—	22.81	13.82	—	13.82
Animal labor	161.14	—	161.14	97.65	—	97.65
Family labor	38.93	—	38.93	23.59	—	23.59
Operator's labor	302.93	—	302.93	183.57	—	183.57
Hired labor:						
Planting	30.38	31.57	61.95	18.41	19.13	37.54
Harvesting and threshing (value of share)	132.18	133.00	265.18	80.10	80.60	160.70
Total expenses	713.83	529.68	1243.51	432.57	320.98	753.55
Percentage of total expenses	57.4	42.6	100.0	57.4	42.6	100.0
Total production, cavans	84.2	84.2	168.4	51.0	51.0	102.0
Net production (harvester's share deducted), cavans	72.0	72.0	144.0	43.6	43.6	87.2

[a] Total of dry-season and wet-season crops.

TABLE 2

Proportion of expenses of production borne by the tenant

PROPORTION	NUMBER OF CASES
per cent	
40–44	6
45–49	8
50–54	20
55–59	42
60–64	18
65–69	6
Total	100

TABLE 3

Returns to tenant and landlord under different share leases [a]

	50-50	55-45	70-30
Tenant:			
Annual share per farm (1.6502 ha.), cavans	72.0	79.2	100.8
Value of share at ₱12 a cavan, pesos	864.00	950.40	1,209.60
Expenses, excluding value of his labor and family labor, pesos	239.79	239.79	303.74
Annual labor income per farm, pesos	624.21	710.61	905.86
Daily labor income, pesos	3.65	4.16	5.30
Landlord:			
Annual share per farm (1.6502 ha.), cavans	72.0	64.8	43.2
Value of share at ₱12 a cavan, pesos	864.00	777.60	518.40
Expenses, pesos	71.92	71.92	7.97
Annual returns on investment per farm, pesos	792.08	705.68	510.43
Annual returns on investment per hectare, pesos	479.99	427.63	309.31
Percentage returns, with land at ₱3,280 a hectare, per cent	14.6	13.0	9.4
Percentage returns, with land at ₱6,000 a hectare, per cent	8.0	7.1	5.2

[a] Total of dry-season and wet-season crops.

ARTIFICIAL PRODUCTION OF PARTHENOCARPIC FRUITS [1]

ADELINO V. ORDOÑO [2]

WITH FOUR TEXT FIGURES

A study (*1*) to compare the effectiveness of naphthaleneacetic acid, indole butyric acid, and naphthoxyacetic acid in inducing the production of parthenocarpic fruits and (*2*) to find the conditions best suited for the artificial production of such fruits was conducted from December, 1949, to October, 1951, in the experimental lot and in the laboratory of the Department of Agricultural Botany, College of Agriculture, Los Baños, Laguna.

MATERIALS AND METHODS

The hormones used were indole butyric acid (IB), naphthaleneacetic acid (NA), thiamine (Th) of the C.P. grade, and naphthoxyacetic acid (NoA).

Tomato seedlings were planted in plots when they were about 8 centimeters tall. Some papaya seedlings were planted in especially prepared hills of soil mixed with sufficient amount of compost.

Just before the dehiscence of the anther, the tomato flower was emasculated and bagged with oil-paper packet to prevent cross pollination. At first it was thought that the application of the chemical had to be timed so that it would coincide with the receptive period of the stigma. Inasmuch as Mann and Minges (1949) found that flowers "from the stage of large buds to those with drying petals may be set by growth substances," the writer sprayed most of the flowers regardless of the receptiveness of their stigmata.

Since the papaya used was unisexual, no emasculation of the flowers had to be done. The female flower buds were bagged and examined. They were treated with the chemicals soon after dehiscence.

Two methods of hormone application were used and compared: smearing with lanolin paste and spraying the aqueous solution with a De Vilbiss atomizer. Smearing was used in 1936 by Gustafson in producing parthenocarpic fruits and was found to be better than the spray method. Spraying, however, is more widely used because it is easier.

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[1] Experiment Station Contribution No. 1608. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1951. Prepared in the Department of Agricultural Botany under the direction of Assistant Professor José R. Velasco.

[2] The writer wishes to express his gratitude to Drs. J. M. Capinpin and D. L. Umali for helpful suggestions in the preparation of the manuscript.

The flower remained bagged until it fell off, or until the ovary showed visible signs of enlarging. The fruits that formed were kept on the plant until they became ripe. Then they were picked, measured, and photographed.

EXPERIMENTS AND RESULTS

The concentration of indole butyric acid and naphthaleneacetic acid sprays. With the object of hitting on a good spray concentration, solutions of IB ranging from 5 parts per million (ppm) to 50 ppm were prepared. They were sprayed on flowers which had been previously emasculated. In order to determine the best time to apply the hormones, one lot of flowers was sprayed in the morning, another at noon, and a third in the afternoon. In all cases (table 1), the different concentrations of IB lengthened the duration of flower attachment [3] by at least twice that of the untreated flowers. There was, however, only one flower among these treatments that set fruit; this was equivalent to an 8 per cent set as against 15 per cent set for the pollinated flowers (control). The results seem to indicate that the 5 ppm concentration is worth further trial and that the variety used has a naturally low percentage of fruit set. The seeds of this variety (Marglobe) were directly imported from the United States and, probably, the variety had not had enough time to adapt itself to local conditions.

Fig. 1.—Showing the fresh corolla on a ripe fruit as a result of the application of 75 ppm naphthaleneacetic acid. (*Photograph by Photographic Division, College of Agriculture*).

[3] Flower attachment was reckoned from the time of the treatment to the time when the flower abscised. Those flowers that set fruit were not included in this observation so as to eliminate exceptionally long durations which might raise the average of an otherwise unexceptional group.

The second experiment (table 2) differed from the first (table 1) in these respects: the plants were native variety of tomato (Susong Kalabao), NA instead of IB was used, and all sprayings were done in the morning only. All the flowers that were sprayed remained attached to the plant up to the time of harvest, that is, thirty-one days after treatment. Their pedicels were robust, but most of the ovaries did not develop. This was in contrast with the pollinated flowers which developed into fruits and ripened in thirty-six days. Again, the flowers that were sprayed retained their corollas until harvest (fig. 1). These observations on indole butyric acid and naphthaleneacetic acid may be of some importance to flower growers who want to prolong the freshness of their flowers.

The effect of the number and frequency of spraying. It was speculated that the failure of 5 ppm IB to bring about a higher percentage of fruit set might have been due to its denaturation sometime after its application. If a constant supply were maintained, there might be a better set of fruits. An experiment was therefore done in which application was repeated at different intervals.

It was found that repeating the application on the second day was markedly beneficial (table 3) in prolonging flower attachment but was inferior to the single application as regards fruit set. It would seem that one application was enough and that subsequent applications were extraneous. One incidental observation was that all the treated flowers set fruit much later (fourteen days) than the pollinated flowers (seven days). In addition, the fruits in the treated lot were three times smaller than those in the pollinated lot.

The effect of thiamine. Data are accumulating which point to thiamine as one of the plant hormones (Bonner and Bonner, 1948). Although there are no studies on the use of thiamine in inducing parthenocarpy, there are indications that during fruit formation, the thiamine of the vegetative parts migrate to the fruits (Geddes and Levine, 1942, *cited by* Bonner and Bonner, 1948). This suggests that thiamine is an important factor in fruiting.

With the object of finding out whether or not thiamine and NA have synergistic action in bringing about fruit set, the writer ran experiments wherein different concentrations of thiamine (Th) were used with 75 ppm of NA. The first trial was done on plants which were growing in garden plots. No fruit was formed in this trial.

Certain factors in the environment are known to adversely affect fruit set. For instance, tomato growers in California can not plant very early in the season. The plants grow luxuriantly, but no fruit is formed, presumably because of low night temperature (Mann and Minges, 1949). Went (1944) found that day temperature of 26°C. and night temperature below 20°C. are conducive to good fruiting in tomato. From his data he postulated that there were two physiological processes governing the fruiting of tomato: (1) a proc-

ess that requires light and a temperature well above 20°C. and (2) another that proceeds in the dark at 17°–20°C.

To slightly modify conditions, some plants were set in kerosene cans which were filled with garden soil and compost. During the treatment the cans were placed on wheeled tables which were pushed out in the open every morning and inside the shed every evening. By so doing, it was figured that the plants would suffer less fluctuations in temperature than the plot-grown plants. Table 4a shows that thiamine had no consistent effect on the percentage of fruit set. It however increased the average size of fruits. All flowers given treatments of NA and Th had significantly bigger fruits than those treated with naphthaleneacetic acid alone (fig. 2). Figure 3,

Fig. 2.—The effect of 2,000 ppm thiamine hydrochloride. Upper right, 75 ppm naphthaleneacetic acid plus 2,000 ppm thiamine. Below, right side, 75 ppm naphthaleneacetic acid. Left, control. (*Photograph by Photographic Division, College of Agriculture*).

on the other hand, shows that the normal fruits (pollinated) were bigger than any of the parthenocarpic fruits.

The results in the first trial were not strictly comparable with those of the second because the plants were grown under different weather conditions. In order to get more information on this subject, plants were started simultaneously in garden plots and in kerosene cans. The flowers were sprayed with 75 ppm of napthaleneacetic acid and with 75 ppm of NA plus 2000 ppm thiamine. Control lots consisting of pollinated flowers were maintained.

Again, the flowers in the plots did not set fruit, while those in the kerosene cans had a percentage of set which approached that of the control (table 4b). In the plot-grown plants, the use of thiamine with naphthaleneacetic acid prolonged flower attachment by only two days, while in the field, the use of naphthaleneacetic acid alone delayed abscission almost indefinitely. In the potted plants, thiamine definitely increased fruit growth, although the final size attained by the fruit was much less than the normal ones. There might have been some factors which were not supplied to the treated flowers. This problem needs further investigation.

Comparison of indole butyric acid, naphthaleneacetic acid, and naphthoxyacetic acid. Sometime during the experiment, Mr. Felipe Maclang of the Shell Company of the Philippines generously offered

Fig. 3.—Comparing size of fruits and time of treatment on the same tomato plant. The fruit on the left was pollinated on December 17, 1950, the one on the right was sprayed with 75 ppm naphthaleneacetic acid and 4,000 ppm thiamine hydrochloride on December 4, 1950. They ripened at the same time. (*Photograph by Photographic Division, College of Agriculture*).

a sample of "Tomato-Set" which his company sells. This is a preparation of naphthoxyacetic acid and other ingredients, the exact composition of which is not known to the writer. The label had directions for proper dilution and use of the preparation. The prescribed

dilution will be designated for convenience as *x ppm*[4] in the following discussion.

Experiments were run in order to compare naphthoxyacetic acid (NoA) with the best concentration of IB and NA on the intact flowers and on the emasculated flowers. It was expected that the data on emasculated flowers would give information on their relative capacity to induce parthenocarpy, while those on intact flowers would give an idea of their ability to supplement the pollen in the setting of fruits.

As shown in table 5, NoA at x/2 ppm produced 26.6 per cent fruit set on emasculated flowers as against 40 per cent fruit set for the pollinated flowers (control). At x ppm, the percentage fruit set of emasculated flowers was the same as that of the control. On the other hand, the percentage fruit set of emasculated flowers with the other compounds were: 5 ppm IB, 40 per cent; 75 ppm NA, 40 per cent; and 75 ppm NA plus 2000 ppm Th, 40 per cent. To compare them rigidly with NoA would not be advisable because these data were obtained at other times (tables 3 and 4a), and conditions might have varied from experiment to experiment.

When sprayed on intact flowers, 5 ppm IB gave 30 per cent fruit set, 75 ppm NA gave 50 per cent, x/2 ppm NoA gave 25 per cent, and x ppm NoA gave 40 per cent. Only NA treatment gave a higher percentage than the control. Incidentally, the chief claim of the sellers of NoA is that it supplements natural fruit set. Apparently, NA can perform the function better. The main disadvantage of NA is that it considerably delays the ripening of fruits.

As regards the size of fruits at maturity, the control was the largest, followed in descending order by x ppm NoA on emasculated flowers, x/2 ppm NoA on emasculated flowers, and x ppm NoA on intact flowers. Their differences, however, were insignificant.

The influence of the time of spraying on the effectiveness of the spray. Not being satisfied with the meagre results obtained in the first experiment on the effect of time of application on the effectiveness of the hormone spray, the writer thought that NoA would be a good spray to use in getting more data on this point. Accordingly, some flowers were emasculated and sprayed in the morning, some at noon, and still others, in the afternoon.

Based on percentage of fruit set and size of fruits, it would seem that among the treated flowers, morning spraying was the best (table 6), followed by the afternoon spraying. The noon spraying was the least effective. It gave, however, a higher percentage of fruit set than in the pollinated flowers (control). It will be noted,

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[4] After this manuscript had been prepared for the press, Mr. Maclang kindly supplied the following information on the composition of "Tomato-Set": Beta-naphthoxy-acetic acid, 590 grams; Tupol 410, 65 gallons; and distilled water, 100 gallons. If the solution is diluted 15 times, the resulting spray is approximately 62 ppm.

on the other hand, that the pollinated flowers produced significantly bigger fruits than any of the treatments. This may be another indication that although hormone sprays supply some of the factors, they can not adequately substitute for the substances found in the pollen.

Experiments with papaya. The first trial with papaya was on the effect of ether extract of corn pollen in inducing parthenocarpy when applied as a lanolin paste. Only one malformed fruit was produced in this trial. This part of the work was discontinued because the supply of pollen was limited.

Two trials (tables 7a and 7b) were run to find the best concentration of IB and NA for papaya. With IB, two fruits were formed at 10 ppm in the first trial and one at 50 ppm in the second trial.

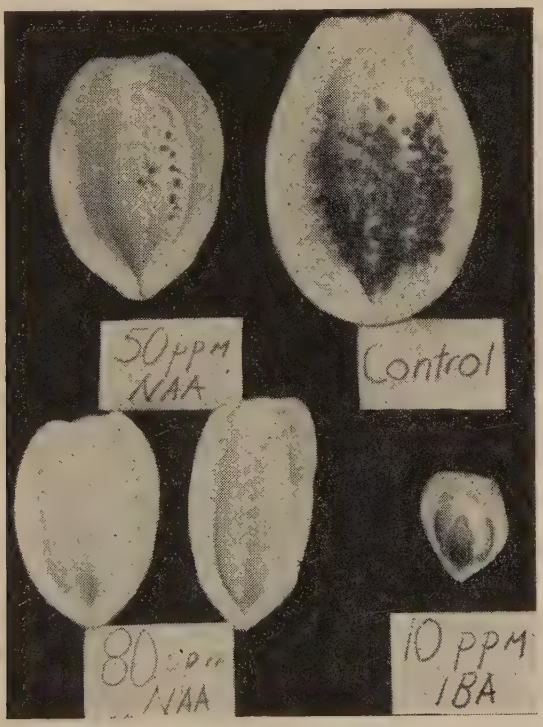

Fig. 4 —The effect of 10 ppm IB and 50 and 80 ppm NA on the size of fruits. (*Photograph by Photographic Division, College of Agriculture*).

In both cases the fruits were inferior to the fruits formed by pollination (fig. 4). All the concentrations of NA tried (50 to 90 ppm) induced the production of parthenocarpic fruits. In one instance (80

ppm), the fruit produced was bigger than the average for the control. It seems that this piece of work merits further study. One of the phases that is worth looking into is the possibility of producing seedless papaya on a large scale.

DISCUSSION

All the synthetic plant hormones that were tried induced parthenocarpic fruit development in tomato. Their effectiveness, however, was conditioned by the weather, as shown by varying degrees of success with a given concentration of a chemical (compare 5 ppm IB in tables 1, 3, and 5, and 75 ppm of NA in tables 2, 4a, 4b, and 5). It is suspected that temperature was the dominant factor that influenced the effectiveness of the different sprays. This suspicion was strengthened by the observations of previous workers (Went, 1944, and Mullison and Mullison, 1948) on the adverse effect of high temperature on flowering and the subsequent processes.

Of the three hormones tried, it seems that IB was the least effective in bringing about parthenocarpy. Mullison and Mullison (1948), working in the Dutch West Indies, observed that IB gave the lowest percentage of parthenocarpic fruit induction in the tomato when it was compared with 2, 4-dichlorophenoxyacetic acid, p-chlorophenoxyacetic acid, B-naphthoxyacetic acid, L (o-chlorophenoxy) propionic acid. On the other hand, Strong (1941) obtained very favorable results with IB in her greenhouse experiments in Michigan. Similarly, Blondeau and Crane (1948) in California found IB effective in inducing development in uncaprified figs. The difference in the results with IB obtained in this study and in that of Mullison and Mullison (1948) on the one hand, and those of Strong (1941) and Blondeau and Crane (1948) on the other, may be ascribed to certain differences in climatic conditions in the tropics and in the temperate zones.

Naphthaleneacetic acid was very effective in preventing abscission. Even in the absence of fruit development, the flowers remained on the plant. Reinders-Gauwentak and Bing (1948) made similar observations in their experiment with the tomato. They found that at 25 mg./li. (25 ppm), the diameter of the pedicel was increased and the early fall of flowers and fruits was prevented.

These few experiments point to the fact that of the hormones tried, naphthoxyacetic acid was most effective in inducing parthenocarpy in the tomato. There were also indications that it tended to hasten the ripening of fruits. Incidentally, there has been citations in literature on the effectiveness of phenoxy and naphthoxy acids and their derivatives in hastening ripening (Blondeau and Crane, 1948, 1950; Weaver and Williams, 1950). It was postulated that these hormones increased metabolic activity, hence the early attainment of maturity.

It would seem that IB and NA exert their influence principally on the abscission layer and are not directly lined with fruit set. Their

indirect function is to maintain the freshness of the flower for a much longer period in order to allow any natural fruit-setting hormone to bring about fruit formation. This makes the setting of fruits in flowers treated with these chemicals rather delayed and very erratic. They are generally very poor substitutes for natural hormone, as evidenced by the much reduced size of fruits.

On the other hand, naphthoxyacetic acid acts in the same place where the natural fruit-setting hormone is found. Its primary function is to induce enlargement of the ovary. The prevention of abscission may be a secondary or an indirect function, indirect if the enlarging ovary produces a hormone (analogous to B-naphthaleneacetic acid or indole butyric acid), which in its turn prevents the formation of the abscission layer.

Some points in this postulated picture of the situation obtained during the hormone treatment of the plants will be the subject of a succeeding experiment.

SUMMARY

1. Different concentrations of indole butyric acid, napthalene acetic acid, naphthoxyacetic acid, and thiamine hydrochloride were sprayed on flowers of two varieties of tomato (Marglobe and Susong Kalabao) in order to induce parthenocarpy.

2. Both indole butyric acid and naphthaleneacetic acid induced enlargement of the pedicel and considerably delayed abscission.

3. As regards fruit set, a single spray of indole butyric acid was better than repeated spraying.

4. Thiamine, when used with naphthaleneacetic acid, increased the size of fruits, but it did not consistently increase the percentage of fruit set.

5. Good-sized parthenocarpic fruits were consistently produced by naphthoxyacetic acid.

6. For supplementing natural fruit set in the field, naphthaleneacetic acid was better than naphthoxyacetic acid.

7. Morning spraying with naphthoxyacetic acid gave a higher percentage of fruit set than either the noon or afternoon treatment.

8. Ether extract of corn pollen, 10 and 50 ppm of indole butyric acid, and 50 to 90 ppm of naphthaleneacetic acid induced parthenocarpy in the papaya. Of these, 80 ppm of naphthaleneacetic acid produced a parthenocarpic fruit which was bigger than the normal fruits.

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TABLE 1

The effect of different concentrations of indole butyric acid and time of spraying on flower abscission and fruit set in Marglobe variety of tomato [a]

CONCENTRATION PPM	NO. OF FLOWERS TREATED	AVERAGE DURATION OF FLOWER ATTACHMENT IN DAYS			NO. OF FRUITS FORMED		
		Morning	Noon	Afternoon	Morning	Noon	Afternoon
5	12	8.66 ± .03	8.36 ± .05	8.16 ± .41		1 [b]	
10	12	7.83 ± .02	7.00 ± .40	8.36 ± .03			1 [c]
20	12	7.33 ± .40	7.00 ± .31	7.16 ± .37			
50	12	7.00 ± .39	7.16 ± .39	6.00 ± .02			
Control	20	3.85 ± .02	3.85 ± .02	3.85 ± .02		6 [d]	

[a] Treatment started Feb. 14, 1950.
[b] Parthenocarpic.
[c] Not parthenocarpic; may have been stray-pollinated.
[d] Three actually developed into fruits; the others remained in the plant without ovary enlargement.

TABLE 2

The effect of different concentrations of naphthaleneacetic acid on fruit set in the native tomato [a]

NO. OF TRIALS	CONCENTRATION PPM	NO. OF FLOWERS TREATED	NO. OF FRUITS FORMED	AV. DURATION OF FLOWER ATTACHMENT IN DAYS
I	5	7	7 [b]	
	10	7	7 [b]	
	20	7	7 [b]	
	50	7	7 [c]	
II	50	15	15 [b]	
	65	15	15 [b]	
	75	15	15 [d]	
	Control	20	4 [e]	11.08 ± 1.76

[a] Transplanted Jan. 30, 1950. The flowers were treated on Feb. 24, 1950.
[b] There was pedicel enlargement but no fruit development even after 31 days.
[c] There was pedicel enlargement, but only one ovary enlarged.
[d] There was a sign of ovary enlargement.
[e] Harvested in 36 days; fruit ripening.

TABLE 3

The effect of number of spraying with 5 ppm. IB on flower abscission and fruit set of the Susong Kalabao variety of tomato [a]

INTERVAL OF SPRAYING	NO. OF SPRAYING	NO. OF FLOWERS TREATED	AV. DURATION OF FLOWER ATTACHMENT IN DAYS	NO. OF FRUITS FORMED	AV. DIAM. OF FRUIT AT MATURITY IN CM.[b]
Once	1	15	24.25 ± 4.09	14 [c]	1.72 ± .02
Repeated daily	7	15	7.41 ± 2.23	6 [d]	
Repeated on the second day	2	15	34.36 ± 2.12	15 [e]	0.94 ± .12
Repeated every two days	8	15	19.60 ± 1.12		
Repeated on the third day	2	15	28.00 ± 1.86	10 [d]	
Repeated every third day	4	15	25.45 ± 2.14	13 [d]	
Repeated on the fourth day	2	15	18.80 ± 2.76	10 [d]	
Repeated every fourth day	3	15	15.00 ± 1.24	5 [d]	
Control	0	15	7.00 ± 0.00	3	3.85 ± .02

[a] Date planted, March 13, 1950; date treated, April 19, 1950.
[b] All the fruits were harvested on June 26, 1950, or 53 days after treatment.
[c] Six actually developed into fruits three weeks after treatment.
[d] The flower did not drop, but there was no ovary enlargement.
[e] Three actually developed into fruits.

TABLE 4a

Effects of different concentrations of thiamine when added to 75 ppm NA [a]

TREATMENT PPM	NO. OF FLOWERS TREATED	NO. OF FRUITS FORMED	NO. OF FRUITS HARVESTED	PER CENT FRUITS HARVESTED	AV. DIAM. OF FRUIT AT MATURITY IN CM.	AV. DURATION OF FLOWER ATTACHMENT IN DAYS
Control	10	5	5	50	3.85 ± .03	10.5 ± 1.43
NA	10	10	4 [b]	40	1.93 ± .03	
NA plus 800 Th	10	10	2	20	2.77 ± .02	
NA plus 1,000 Th	10	10	2	20	2.09 ± .01	
NA plus 2,000 Th	10	10	4	40	2.42 ± .02	
NA plus 4,000 Th	10	10	3	30	2.35 ± .39	

[a] Planted October 14, 1950; these results were obtained from pot-grown plants.
[b] The corollas of the treated plants were still intact up to harvest time. Shiny fruit developed.

TABLE 4b

Comparison of the effect of the sprays on plants grown in plots and in pots [a]

TREATMENT PPM	NO. OF FLOWERS TREATED	AV. DURATION OF FLOWER ATTACHMENT IN DAYS	AV. DIAM. OF FRUIT AT MATURITY IN CM.	NO. OF FRUITS FORMED	PERCENTAGE OF FRUIT SET
Plants in the plots					
75 NA	15 [b]				
75 NA plus 2,000 Th	10	14.00			
Control	20	12.25 ± 0.90	3.43 ± 0.02	8	40
Plants in pots					
75 NA	10 [b]		1.93 ± 0.03	4 [c]	40
75 NA plus 2,000 Th	10 [b]		2.42 ± 0.02	4	40
Control	10	10.50 ± 1.43	3.85 ± 0.03	5	50

[a] Planted October 14, 1950. The flowers were treated on November 21, 1950.
[b] Flowers that did not develop into fruits did not fall off.
[c] The fruits were harvested and measured when they showed signs of ripening, or 50 days after treatment on the average. Corollas were still fresh at harvest.

TABLE 5

Average duration of flower attachment, percentage of fruit set, and comparative diameter of fruits produced by the different sprays [a]

KIND AND CONCENTRATION OF SPRAY	CONDITION OF FLOWER	NO. OF FLOWERS TREATED	AV. DURATION OF FLOWER ATTACHMENT IN DAYS	PERCENTAGE OF FRUIT SET	NO. OF DAYS FROM TREATMENT TO RIPENING	AV. DIAMETER OF FRUIT AT MATURITY IN CM.
Control		20	12.25 ± .90	40	22.25	3.43 ± .02
5 ppm IB	emasculated [c]	15	24.25 ± 4.09	40	44.20	1.72 ± .02
	intact	20	16.00 ± 0.78	30	21.15	3.07 ± .01
75 ppm NA ...	emasculated [c]	10		40	49.80	1.92 ± .03
	intact	20	22.66 ± 2.92	50	37.50	3.18 ± .01
75 ppm NA + 2,000 ppm Th	emasculated [c]	10		40	62.70	2.42 ± .39
x/2 ppm NoA .	emasculated [c]	15	14.70 ± 1.72	26.6	24.63	3.27 ± .40
	intact	20	18.13 ± 1.07	25	22.00	3.18 ± .02
x ppm NoA ..	emasculated [c]	15	16.33 ± 1.25	40	21.60	3.22 ± .32 [b]
	intact	20	19.09 ± 1.52	40	28.95	3.40 ± .38

[a] Date planted, December 26, 1950; treatment started February 4, 1951.
[b] Two of the fruits harvested were found seedless.
[c] These data were obtained from other experiments (tables 3 and 4a), but they were included here for casual comparison.

TABLE 6

The relation between time of spraying and effectiveness of naphthaleneacetic acid on pot-grown plants

TREATMENT	NO OF FLOWERS TREATED	NO. OF FRUITS FORMED	PERCENTAGE OF FRUIT SET	AV. DURATION OF FLOWER ATTACHMENT IN DAYS	AV. DIAM. OF FRUIT AT MATURITY IN CM.
Morning	14 [a]	13	92.80		3.81 ± 0.35
Noon	18 [a]	11	61.10		3.36 ± 0.60
Afternoon	15 [a]	11	73.33		3.45 ± 0.54
Control	15	8	53.33	16.33 ± 2.13	4.48 ± 0.65

[a] The flowers which failed to develop into fruits did not drop off.

TABLE 7a

The effect of varying concentrations of indole butyric acid and naphthaleneacetic acid on papaya fruits [a]

CONCENTRATION PPM	NO. OF FLOWERS TREATED	NO. OF FRUITS FORMED	AV. MEASUREMENT OF FRUIT AT MATURITY	
			Length in cm.	Width in cm.
NA				
80	10	3 [b]	16.7 ± 1.26	11.3 ± 0.80
50	10	2 [c]	22.2 ± 2.05	14.4 ± 0.90
IB				
20	10	—		
10	10	2 [d]	7.7 ± 0.70	5.8 ± 0.84
Control	10	4	23.2 ± 0.63	16.2 ± 0.23

[a] Treatment was started May 30, 1950.

[b] The fruits were smaller than those treated with 50 ppm NA; no seed, only thin flesh.

[c] The fruits were smaller than those of the control but bigger than those treated with 80 ppm NA; the flesh was thinner than the control but thicker than those treated with 80 ppm NA; seeds few.

[d] The fruits were smaller than those treated with either of the concentrations of NA; the inner structure cracked and dried.

TABLE 7b

The effect of varying concentrations of indole butyric acid and naphthaleneacetic acid on papaya fruits [a]

CONCENTRATION PPM	NO. OF FLOWERS TREATED	NO. OF FRUITS FORMED	AV. MEASUREMENT OF FRUIT AT MATURITY	
			Length in cm.	Width in cm.
NA				
90	10 [c]	1	18.9	11.5
80	10 [c]	1	23.7	13.1
70	10	2 [b]		
60	10	3	11.4 ± 3.32	6.5 ± 2.79
50	10	1	19.3	7.0
IB				
50	10	1	14.4	10.1
20	10			
10	10			
Control	10	4	21.3 ± 1.10	14.6 ± 1.18

[a] The treatment was started on October 11, 1950.

[b] The tree bearing the flowers treated was blown by the typhoon on December 30, 1950. The fruit when cut was found seedless.

[c] No fruit formed.

THE BLACK PEPPER CULTURE IN THE COLLEGE OF AGRICULTURE AT LOS BAÑOS [1]

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WITH TWO TEXT FIGURES

Owing to the increasing demand for black pepper in the United States and in the Philippines, the suitability to the crop of the soil and climate in many provinces, and the comparative ease of raising the crop, the possibilities of growing black pepper for export merit the attention of Filipino farmers.

To give an idea of how to produce good quality black pepper in large quantity at a reasonable cost, the writer describes briefly the method of growing this spice in the College of Agriculture.

BLACK PEPPER FOR COMMERCE

The commercial black pepper, *Piper nigrum* Linn. var. *trioicum* CDC, grown in the Philippines is a long climbing shrub producing flexuous stems with small aerial roots at the swollen nodes. Its leaves are entire, ovate to nearly orbicular, pointed, longitudinally nerved, thick, and dark green. The flowers are white, spicate, minute, and dioecious. The fruits are small, nearly spherical, and borne on short, hanging spikes or catkins, 4 to 12 cm. long. The fruits, 3 to 6 mm. in diameter, are nearly globose. At first they are dull green, but they become red at maturity. When dried, the ripe berries become black and wrinkled. These constitute the black pepper of commerce. The dried berries without the outer coverings constitute the white pepper of commerce.

The commercial varieties of black pepper grown in Madras are two varieties of Balamcotta, the wavy-leaved and the small-leaved. *Kallivalli* pepper is a good cropper although it does not flush regularly. The *Cherikadi* is a dwarf variety and it produces only small spikes. Four kinds are reported growing in Malabar: *Sadharana valli, Kallivalli, Koltavalli,* and a short-leaved pepper. *Trang Pepper* is a variety cultivated in northern Siam. Its peppercorns are small, its spikes long, and its fragrance pungent. *Trang Pepper* stands the milling process better than any other variety. It commands the highest price in the market. There are also some Sumatran varieties: *Lada Kawur, Lada Manna,* and *Lada Jambi.* In addition to these, dwarf pepper is grown. This variety is erect in habit and is a good cropper. Its fruits are easy to gather because of its dwarfness. Nevertheless, it is not recommended for commercial growing because it does not give as big a yield from a hectare of land as from a vine with a stem 3 to 4 meters long.

[1] Experiment Station Contribution No. 1609.

A physical analysis of the College-grown pepper and the pepper sold in the retail stores in Los Baños, Laguna, was made. For this purpose, the spikes were gathered when only a few of the fruits were ripe and red. The fruits were spread on a "bilao" to dry in the sun. The dry and black fruits were rolled between the hands to separate them from the stalks. All of the broken parts were removed by winnowing and the clean fruits were stored in clean and dry mason jars. The results of the physical analysis are as follows:

	PEPPER GROWN IN THE COLLEGE	PEPPER SOLD IN THE RETAIL STORES
Samples analyzed (5 trials)	1 dl.	1 dl.
Average number of peppercorns	1,052.0	1,469.3
Average weight in grams	45.3	30.8
Average number of hard, good peppercorns	1,031.7	689.3
Average number of empty, poor peppercorns	20.3	780.0
Percentage of hard, good peppercorns	98.13	46.05
Percentage of empty, poor peppercorns	1.87	53.95

One deciliter of black pepper costs ₱1.00 in the retail stores.

The distribution, extent of cultivation, yield, and climatic requirements of the black pepper in the Philippines

The black pepper is grown in many places in the Philippines.[2] The most important of these places, the area planted, the types of climate of the region, and the yields in kilograms are shown below:

LOCALITY	YIELD IN KILOGRAMS	TYPES OF CLIMATE	AREA PLANTED (in hectares)
I. Mindanao:			
Cotabato	5	4th	.02
Lanao	80	"	.21
Misamis Oriental	8	2nd	.08
Total	93		.31
II. Visayas:			
Bohol	282	4th	.67
Capiz	70	"	.05
Cebu	4,979	3rd	3.17
Iloilo	2,408	1st & 3rd	1.75
Leyte	50	2nd & 4th	.21
Masbate	166	3rd	.37
Negros Occidental	2,297	1st & 4th	2.35
Negros Oriental	143	3rd	3.34
Samar	2	2nd	.17
Total	10,397		12.08
III. Bicol regions:			
Albay	3,309	2nd & 4th	23.48
Camarines Sur	33	2nd & 4th	.01
Sorsogon	3,650	2nd	1.83
Total	6,992		25.32
IV. Luzon:			
Batangas	62	1st	.27
Cagayan	264	2nd, 3rd, 4th	.31
Laguna	104	1st	.01
Total	430		.59
Grand total for the Philippines	17,912		38.30

[2] BAQUI, FLORENCIO. 1911. Black pepper in Batangas. Philippine Agriculturist and Forester 1: 136.

This tabulation shows that most of the black pepper in the Philippines is grown in the fourth type of climate where there is no very pronounced maximum rainy period and no dry season. The rainfall should not be less than 2 to 2.5 meters a year and should be evenly distributed. As shade is essential, black pepper gardens should be established in forest clearings. The black pepper plant thrives in the warm, humid climate of the College about 35 meters above sea

Fig. 1. Appearance of a well-developed pepper plant in the College of Agriculture planting (*Photographed by the Photographic Division, College of Agriculture*).

level. The plant is grown on living supports in a light shaded place (fig. 1), which is free from strong winds. When grown in exposed places, black pepper suffers from the long dry days and strong winds.

THE CULTURE OF BLACK PEPPER

The black pepper is a hardy plant which grows in most soils. In the College, black pepper thrived best in the deep, loose, well-drained, dark-colored vegetable loam near the bank of the Molawin Creek. The stiff and poorly drained soil and the steep hill sides of the Faculty Hill produced poor crops.

A second growth forest is suitable for growing black pepper on a commercial basis. During the dry months of the year, all but leguminous trees which can furnish partial shade and supports for the pepper vines should be cut down. All felled trees and branches may be cut into pieces and allowed to dry or decay on the spot. Some of the big leguminous trees may be pruned, or additional trees for support may be planted if needed.

In our work at the College, several trees have been tested for supports of the pepper plants. Only two kinds of trees, the madre de cacao, *Gliricidia sepium* (Jacq.) Steud, and ipil-ipil, *Leucaena glauca* (Linn.) Benth., both of the family Leguminosae, were found suitable for the purpose. These trees were easily propagated by cuttings; they grew rapidly and were sufficiently strong to carry the weight of the vines of the pepper plant.

The pepper grown in the College was propagated by cuttings because this method insures early fruiting and the plants usually grow true to type. For this purpose, cuttings 45 cm. to 60 cm. long, with not less than seven joints, were made from the ends of the productive vines during the rainy months. The cuttings were made just a little below a node with sharp pruning shears. The old leaves from the lower two nodes were removed and the cuttings were either planted first in nursery beds in a moist and shady place, or directly near their supports in the field.

When the pepper planting was started from seeds, ripe seeds were selected from healthy and productive vines. The seeds were first soaked in water for three days and their outer skin removed. The seeds were air-dried in the shade and sown in hills in the nursery beds. The seedlings had to be watered frequently. They were ready for transplanting when they had four leaves.

The lower portion of the cutting was planted about 10 to 15 cm. deep; the upper part was tied against the support with strips of abacá or banana leaf sheath. The base of the cutting was mulched. The soil around each cutting was not heaped up. The planted vines were watered until the vines produced enough roots to attach themselves to their supports. Other methods of culture of black pepper followed in other countries were described by Ridley [3] in 1912.

When the plantings were growing well, the vines were carefully weeded and mulched with decomposed leaves, grasses, or other vegetable matter. The mulch protected the roots from the sun and

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[3] Ridley, H. N. 1912. Spices. ix + 449 p. London: MacMillan Company, Ltd.

kept the ground moist and cool. Too much mulching, however, was avoided lest the pile become a breeding place for ants or a substrate for fungi which might attack the pepper vines.

The tips of the vines which had climbed up their supports were nipped off to induce the emergence of the lateral shoots. The living supports were kept pollarded to prevent too much shade. When the pepper vines were 1.5 meters long, they were carefully detached from their supports, and their ends were coiled and buried in the soil so as to induce more vigorous growth and to insure a large crop (fig. 1).

The vines were manured on the surface of the soil, but the manure layer was covered thinly with good soil. The Chinese pepper growers of Singapore use burnt earth extensively as manure. They also use rotten fish to advantage. In Batangas province, cattle or horse manure is usually applied around the black pepper hills.

Enemies of the pepper crop

In 1940, Vimuktanandana and Celino [4] described the anthracnose of pepper caused by *Collectotrichum nigrum* E. & H. as occurring on pepper in the College and its neighborhood. This disease, however, is seldom of economic importance. In his pepper culture at the College, the writer noted a number of diseases attacking the black pepper vine: canker, infection of eel-worm, fungus hyphae on the vessels, and dying vines. There are diseases of black pepper reported in some European countries which were not present in the writer's cultures. A root fungus, *Dematophora necatrix,* is also reported on black pepper.

Among the important insect pests were larvae of two beetles, *Cyrtanthacris varia* and *Aspidiotus destructor* Sign. Scale insects and mealy bugs attacked black pepper plantings in the College.

The giant African snail, *Achatina fulica,* was found on black pepper vines and on their supports, but it did not appear to be destructive.

A bird, *Stachyris nigrocapitata,* known as the "pulanga," was seen on the College pepper eating the ripe fruits on the spikes as soon as they began to turn red. This bird, when not driven away, reduced the yield considerably.

Harvesting and preparation of the crop for the market

In the College cultures, the black pepper began to fruit in about three years after planting. The berries did not ripen at the same time. As soon as the oldest fruits on the spike began to turn red, the entire spike was picked by hand. As some of the experimental pepper vines were old and tall, the laborers used bamboo step ladders in harvesting. There were two crops of pepper a year; the

[4] Vimuktanandana Yan Yong, and Martin S. Celino. 1940. Anthracnose of black pepper, *Piper nigrum* Linn. Philippine Agriculturist 29: 124–149. *Fig. 1–15.*

first crop was harvested in August and September, and the second, in March and April. Flowers and berries of different stages of maturity were found on the vines. There was a considerable variation in the yield. The experimental pepper vines in the College (fig. 2) gave a minimum yield of 1 to 2 deciliters, or 20 to 40 grams of black peppercorns each in the first crop year, that is, three years after planting.

Fig. 2. Fruiting branches of the pepper plant, showing the spikes loaded with fruits. (*Photographic Division, College of Agriculture*).

An analysis of 150 pepper spikes of the variety *trioicum* grown in the College showed that the spikes had an average length of 6.94 $\mp$ 0.611 cm.; the average number of developed peppercorns on the spike was 18.36 $\mp$ 0.240; and the average percentage of developed peppercorns was 55.50 $\mp$ 0.833.

The spikes varied in their load of peppercorns. A good pepper spike should have the peppercorns of the same maturity closely pressed together without empty spaces between them.

The crop may be marketed either as black or white pepper. For black pepper production, the spikes were picked by hand as soon as a few of the fruits were ripe, as shown by the reddish color. The fruits were spread on mats or "bilao" to dry in the sun. The dried black pepper were rolled between the hands in order to detach them from their spikes; the refuse was removed by winnowing. The shrinkage of the fruits was found to be 50 per cent or more. Measurements made by the writer showed that 330 spikes were required to make 6 deciliters of black peppercorns. For improving the color of the pepper, it is suggested that the spikes be dipped in boiling water before they are dried. The boiling water hastens drying, kills the young green fruits immediately, and blackens them quickly. The hot water treatment renders the skin tougher and gives the pepper a better color.

The white pepper of commerce is composed of the ripe seeds without the skin and pulp. In white pepper production, the writer harvested the fruits when they were all red. The method of preparation of white pepper in the College consisted of removing the fruits from the spikes, placing the berries in cloth bags, and soaking the bags in water from seven to ten days. When the skin was loose and soft, the berries were placed in a vat and the seeds rolled between the hands to loosen the skin and pulp. The skins, pulp, and stalks were removed by thorough washing in water. The peppercorns were dried in the sun on "bilao" or mats. It took 350 spikes to yield 5 deciliters of white peppercorns, and 250 spikes to produce 4.5 deciliters of ground white pepper weighing 228 grams.

SUMMARY

1. In the College of Agriculture at Los Baños, the black pepper, *Piper nigrum* Linn. variety *trioicum* CDC, thrived well in warm and moist places which are partially shaded and protected from strong winds.

2. Cuttings from the ends of vigorous vines were used for planting, with *Gliricidia sepium* and *Leucaena glauca* as live supports.

3. The pepper plants gave two crops a year three years after they were planted. The first crop was harvested in August and September, and the second, in March and April.

4. The worst enemy of the crop was the bird "pulanga," *Stachyris nigrocapitata,* which ate the ripe peppercorns.

5. The black pepper produced in the College was of better quality than that sold in the retail stores in Los Baños. It had only 1.87 per cent of one deciliter of empty and poor peppercorns, whereas the pepper in the retail store had 53.95 per cent. Harvesting only fully matured peppercorns improved the quality of pepper produced.

6. A pungent white pepper, which compares favorably with the imported white pepper, was produced from the pepper crop of the College.

THE FLORAL BIOLOGY AND FRUCTIFICATION OF PEANUT, ARACHIS HYPOGAEA [1]

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WITH TWO TEXT FIGURES

Because of their value in the establishment of pure strains in the peanut and in the artificial production of crosses, a study of floral biology and its relation to pod formation was made by the writers in the Department of Agricultural Botany from July, 1949, to October, 1950. Bledsoe and Harris [2] found that in the peanut, the gynophore has a stem-like anatomy and a root-like behavior.

MATERIALS AND METHODS

The Spanish White, a bunchy type variety of peanut, and the Southeast Runner, a trailing type variety, were used in this experiment.

At first, cans 30 centimeters in diameter and 30 centimeters high were used for planting. Later, gasoline drums cut into halves were used for the duration of the experiment with the runner type. The cans, provided with drainage holes at the bottom, were filled with mixed loamy soil and about 10 per cent sand.

The plantings were made on August 20, 1949, August 27, 1949, January 7, 1950, and April 24, 1950. The five seeds planted in each container were thinned to one plant when they were eight centimeters high. In the first and second plantings, five plants of each variety were used; in the third planting, ten; and in the last planting, twenty. The plants were harvested when they were four and one-half months old.

At the earliest sign of flowering, a study was made of the form and position of the developing buds. Flowers in different stages of development to the opening and subsequent withering of the corolla were collected at intervals from September, 1949, to December, 1949, and from February 1, 1950, to April, 1950, for macroscopic and microscopic examinations and the opening of the flowers, dehiscence of pollen, and the duration of each stage.

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[1] Experiment Station Contribution No. 1610. Part of the thesis presented by the junior author for graduation, October, 1950, with the degree of Bachelor of Science in Agriculture.

[2] BLEDSOE, R. W., AND H. C. HARRIS. 1950. The influence of mineral deficiency on vegetative growth, flower and fruit production, and mineral composition of the peanut plant. Plant Physiology 25: 69–77.

RESULTS AND DISCUSSION

Flowering habits of peanuts of the bunchy and runner types. The peanut plants produced many blooms which were borne in the form of contracted bracteate clusters in the axils of the leaves. The individual flower is held on a short pedicel in a more or less upright or oblique position. Its calyx is a slender tube resembling a pedicel. The calyx has five lobes; four of these are connate and the fifth and lower one is free. The corolla is typically papilionaceous, yellow to whitish in color, and borne at the end of the calyx tube. It has a broad, large, suborbicular standard and oblong separate wings, free from an incurved beaked keel. There are ten stamens borne at the top of the calyx tube, but all of them may not be fully developed. The anthers are of two kinds: one is two-celled and the other, one-celled; they are borne alternately. The two-celled and elongated anthers are more or less basifixed, but the one-celled and subglobose are versatile. The ovary is located at the base of the calyx and is two-to three-ovuled. The style is very long and slender and is terminated by a stigmatic surface at the tip. In mature flowers, the stigma lies buried along the dehisced anthers in the tightly closed keel petal. Self-fertilization is thus assured.

Fig. 1.—Normal fructification of peanut plant: left, runner type, and right, bunchy type.

Anthesis. In the experiment to determine the length of anthesis in the flowers of Spanish White and Southeast Runner varieties, it was noted that signs of opening appeared at about three o'clock in the morning, and by four o'clock, the majority of the flowers had opened. All the flowers under observation were open by five o'clock.

Some flowers from both varieties showed signs of opening as early as about two o'clock in the morning; none opened in the afternoon.

Dehiscence. The time of dehiscence of the anthers is of importance in the hybridization work. In the experiment on November 13, 1949, all the anthers of the five flowers studied dehisced at about four o'clock in the morning of November 14, 1949. The dehiscence and anthesis were synchronous and insured self-pollination.

The experiment to find out the possibility of development was inhibited when the pegs were prevented from touching the ground (figures 1 and 2). This finding corroborates that of Bledsoe and Harris in 1950, that the ovary of the aerial flower must be transformed by a gynophore to a subterranean position before maturation of the fruit could normally occur. These authors further state that water and darkness are essential to fructification, and soil extract beneficial.

Regularity of blooming. Flower production was very regular in the forty plants of each of the bunchy and runner varieties. On the

Fig. 2.—Effect of preventing gynophores of peanut plants from touching the ground: left, runner type, and right, bunchy type.

average, the bunchy type variety flowered 32.2 days after planting, and the runner type variety, in 31.6 days. A crop of blossoms was produced every 24 hours. A study of 100 flower buds showed that

those from 2.0 to 2.5 centimeters from the base of their calices usually opened the following morning. Each day, the flowers which appeared were almost of the same stage of development.

Growth of the calyx tube. The flowers which opened the following morning had their corollas out of their calyx lobes. The calyx tube continued to elongate until the flower opened, at which time the tube reached its full development. In an experiment to find the rate of growth of the calyx tubes, 50 flowers, with their corollas barely out of their calyx lobes, were marked at eight o'clock in the morning of October 15, 1949, and the calyx tubes were measured after ten hours and again the following morning. It was observed that the elongation was at an average rate of 1.30 centimeters in the first ten hours and 3.24 centimeters overnight. When they reached full development after 24 hours, the average length of the pegs was 4.54 centimeters.

Percentage of success of artifically pollinated flowers. On February 18, 1950, 50 flowers of each of the bunchy and runner varieties which were supposed to open the next day, and which ranged in length from 2 to 2.5 centimeters, were emasculated between six and seven o'clock in the afternoon. Stokes and Hull [3] found that, generally, the best time for emasculating peanut by grasping with a pair of scissors is during the 30 minutes preceding the bursting of the anthers. According to these authors, the pollen is somewhat oily at this stage and there is little danger of its blowing about. The writers noted that pegs failed to develop when fertilization was not accomplished. This observation was confirmed when 50 flowers from each of the two varieties were emasculated and left with one-half of the petals torn away and the stigma exposed fully. None of the flowers showed evidence of fertilization. Since Stokes and Hull (1930) further stated that there is no special precaution necessary for preventing accidental mixture of crossing in the field, as self-fertilization occurs very early in the peanut flower, the writers did not protect the emasculated flowers even after pollination.

In the pollination done between eight and ten o'clock in the morning after emasculation, the pollen from the bunchy variety was used for pollinating the runner variety, and that of the runner variety for the bunchy variety. The subsequent development of gynophores was the criterion of pollination or fertilization. Of the 50 flowers of each of the two maternal varieties pollinated, only 23 gynophores in the bunchy type and 21 gynophores in the runner were found. The success of cross-pollination in the bunchy type was 46 per cent and in the runner type, 42 per cent, or an average of 44 per cent for the two types. This result agrees with that of Stokes and Hull.

For comparative purposes, 50 flowers of each of the two varieties were taken at random, marked, and allowed to self-pollinate.

[3] Stokes, W. E., and F. H. Hull. 1930. Peanut breeding. Jour. Amer. Soc. Agron. 22: 1004–1019.

Seventy per cent of the naturally pollinated flowers of the two varieties formed pegs, 68 per cent in the bunchy, and 72 per cent in the runner. As Stokes and Hull noted that the presence of developing fruits on a plant may inhibit blooming or the development of pegs after fertilization, the writers also removed from the plants all the other flowers that developed after pollination. The pruning of the pegs was stopped after the crosses had their blooms.

The appearance of gynophores or pegs after fertilization. A record made of the intervals in days between pollination and the appearance of pegs showed that in the artificially pollinated flowers, the average interval was 4.4 days for the bunchy and 4.6 days for the runner variety. It was also noted that natural fertilization was accompanied by an early appearance of the gynophores and that the flowers were fertilized on the day they withered.

Stages of development of gynophores. As soon as fertilization had taken place, the petals withered on the same day that the flower opened. The flower stalk elongated downwards, pushed the fertilized ovary, which was still protected by the calyx and the flower, remained in the soil, developed, and matured in about six weeks.

Distance of pegs or gynophores from the ground. The distance of the gynophores from the ground was determined by taking at random from five plants of each variety planted on August 27, 1949, 50 newly developing pegs. When the pegs had penetrated the soil, measurements made from the point of origin to the ground showed that in the runner variety the distance was 6.69 centimeters and in the bunchy variety, 5.26 centimeters. Some of the pegs attained a length of 15.6 centimeters. They developed pods, too.

Frequency of blossom from time of planting. The peanut plants of both varieties flowered continuously from the time they showed first signs of blooming to the time the plants were ready for harvest at the age of three and one-half months. Flowering was regular throughout this period and had a slight tendency to increase after about 100 days. A significant difference in the blooming period was noticed between the runner variety and the bunchy variety. The total number of flowers was significantly increased in the runner variety when the developing fruits were removed from the plants. When compared with the control plants, the difference in flower production and pod formation was insignificant in both varieties. The results indicate that the flowering and fructification of the bunchy variety were not influenced by the treatments for inducing blooming.

SUMMARY

1. Flower production in peanut was regular and continuous. The flowers of each day were in about the same stage of development. The peanut flowers were entirely self-pollinated. The an-

thers dehisced during the night and before dawn; the flower was fully opened and withered on the same day.

2. The gynophores were positively geotropic. No pegs developed until after fertilization and when they were outside of the soil.

3. The runner type variety significantly excelled the bunchy type in vegetative growth and in flower and pod production. In the bunchy type variety, the pegs that formed pods appeared at the base of the plant, whereas in the runner type variety, the pegs appeared in the leaf axis of the prostrate branches.

4. By removing the developing fruits and pegs, production of flowers was induced on a normal plant of the runner variety which had not flowered for sometime.

WATER-TREATED IPIL-IPIL (LEUCAENA GLAUCA LINN.) SEED MEAL IN RATIONS FOR GROWING CHICKS [1]

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Baclig and Fronda (1949) reported that chicks given rations containing five per cent roasted ipil-ipil seed meal did not grow as fast as those given rations without ipil-ipil seed meal. It is possible that the feeding value of the ipil-ipil seed meal may be improved by washing with water, as suggested by Borchers [2] who found that ipil-ipil seeds are positive for trypsin inhibitor. Following this suggestion, three trials were conducted in the Department of Animal Husbandry from July, 1948, to February, 1949, to test the value of water-treated ipil-ipil seed meal in rations for growing chicks.

MATERIALS AND METHODS

Two hundred eighty New Hampshire baby chicks were used in the study. The first and third trials consisted of two lots of 50 chicks each, and the second trial, 2 lots of 40 chicks each. The chicks were wing-banded, weighed individually, and placed in properly ventilated, unheated brooding pens. Each trial lasted for twelve weeks.

The rations used consisted of the following ingredients, all parts by weight:

FEEDS	LOT I	LOT II
Fine rice bran	55	55
Ground corn	20	20
Fish meal	20	15
Copra meal	5	5
Ipil-ipil seed meal	—	5
Common table salt—1 per cent of mash for the two lots.		

Dried mature ipil-ipil seeds, including the shells, were ground small enough to pass through a 15-mesh wire sieve. The ground product was treated with approximately five times its volume of water and allowed to stand for 24 hours at room temperature. At the end of the soaking period, the water which remained unabsorbed was thrown away and the soaked material dried in the laboratory with infra-red lamps.

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[1] Experiment Station Contribution No. 1611. Based upon the thesis presented for graduation by the senior author with the degree of Bachelor of Science in Agriculture from the College of Agriculture, 1949. Prepared in the Department of Animal Husbandry under the direction of the junior author.

[2] A communication dated February 10, 1948, received from Borchers of the Department of Agricultural Chemistry, University of Nebraska, Lincoln, Nebraska, U. S. A.

The proximate chemical analysis of this meal is as follows:[3]

	PER CENT
Moisture	11.74
Ash	1.70
Protein	21.47
Total carbohydrates	35.43
Fat	9.46
Crude fiber	20.20

The rations were given in the form of dry mash and made available to the chicks at all times of the day. Chopped green feed was given every morning. Fresh water was also supplied at all times. All the chicks in each lot received uniform care and management throughout the experiment.

Records of initial and weekly weights, amount and cost of feed consumed, and percentage of mortality were kept.

RESULTS AND DISCUSSION

Rate of growth. The figures given in table 1 show only a slight difference between lots I and II in the average initial and final weights of the chicks in the three trials. At the end of the second week, the average weights of the birds in both lots rose to more than twice their initial weights. After twelve weeks, the mean weight of the chicks in lot I was 941.9 $\pm$ 36.91 grams, and of those in lot II, 889.6 $\pm$ 34.33 grams. These weights were very much higher than those reported by Baclig and Fronda (1949) and Mondoñedo (1950).

Compared with the basal ration, the ration containing water-treated ipil-ipil seed meal did not show growth-depressing effect which was reported by Beaumont (1945) to be due to a toxic substance identified as mimosine ($C_8H_{10}N_2O_4$). Washing the ipil-ipil seed meal with water and exposing it subsequently to heat-producing infra-red rays may have removed this toxic substance.

The three trials made in this study did not differ in average weekly gain. The weights of the birds in lot I, which received fish meal as the sole protein supplement, and of those in lot II, which received 5 parts by weight of water-treated ipil-ipil seed meal and 15 parts by weight of fish meal as protein supplement show that water-treated ipil-ipil seed meal may be a good protein supplement of fish meal rations for growing chicks.

Feed consumption. Table 2 shows that the birds in lot I consumed a little more feed than those in lot II. This may be explained by the fact that the birds in lot I were slightly bigger than those in lot II and not because the chicks given ipil-ipil meal did not relish the feed. Contrary to the findings of Pizarro (1947) and

[3] Analyzed by the Department of Agricultural Chemistry.

Baclig and Fronda (1949), the chicks used in the present study did not discriminate against the ipil-ipil seed meal. Apparently the feed containing water-treated ipil-ipil seed meal was palatable to them.

The data in table 2 also show that the birds in lot II consumed less feed to produce a kilogram gain than those in lot I. The average feed consumption needed to produce a kilogram gain in lot I was 5.38 kilograms; that in lot II, 5.22 kilograms. The cost of feed was ₱1.72 and ₱1.61 respectively. These figures would seem to indicate that the ration with the water-treated ipil-ipil seed meal was more efficient than that without.

Mortality. As shown in table 2, the average percentages of mortality in lots I and II were almost the same (lot I, 54.00 per cent; lot II, 54.16 per cent). Baclig and Fronda (1949) reported a mortality of 65.12 per cent in the lot that received the normal ration and 76.74 per cent in the lot that received the experimental ration. They attributed the difference to the low vitality of the chicks in the experimental lot as a result of the feed given them.

Of the three trials made in this study, the second suffered the greatest mortality. This was mainly due to the occurrence of coccidiosis and roup during the fourth week of the experiment. Three of the chicks in lot I of the first trial were swallowed by a boa sometime during the first week of the experiment. Two cases of cannibalism, with fatal results, were observed in lot II during the sixth and seventh weeks of the third trial. Cases of fowl pox and roup were found in both lots of all the three trials. In the suspected cases of coccidiosis, the birds were given sulfaguanidine.

SUMMARY

1. The feeding of water-treated ipil-ipil seed meal to growing chicks as supplementary ration did not cause growth depression.

2. The toxic substance in the ipil-ipil seed meal may have been inactivated, transformed, partially removed, or completely washed away by simple water treatment and by drying with infra-red lamps.

3. The chicks relished the experimental ration given them.

4. The mixture of 5 parts water-treated ipil-ipil seed meal and 15 parts fish meal, all parts by weight, in rations for growing chicks produced as good results as the rations that contained 20 parts fish meal alone.

TABLE 1

Average biweekly weights of chicks

AGE	LOT I	LOT II
	grams	*grams*
Initial	41.4 ± 0.60	39.9 ± 0.54
2 weeks	86.5 ± 1.57	85.6 ± 2.00
4 weeks	173.3 ± 4.87	185.1 ± 5.09
6 weeks	284.6 ± 10.17	315.6 ± 13.42
8 weeks	454.4 ± 17.93	494.3 ± 21.38
10 weeks	694.4 ± 27.60	720.0 ± 27.56
12 weeks	889.6 ± 34.33	941.9 ± 36.91

TABLE 2

Amount and cost of feed consumed, based on 100 chicks raised to twelve weeks of age, and mortality

ITEMS	LOT I	LOT II	DIFFERENCE
Total feed consumption, kilograms	507.00	465.00	42.00
Feed consumption for each bird, kilograms	5.07	4.65	0.42
Feed consumed by a kilogram weanling, kilograms	5.38	5.22	0.16
Cost of feed consumed by a kilogram weight, pesos [a]	1.72	1.61	0.11
Mortality, per cent	54.0	54.16	0.16

[a] Cost of feed a kilogram for lot I, ₱0.32, and for lot II, ₱0.31.

THE RURAL HOUSING CONDITIONS OF ONE HUNDRED FAMILIES IN MASARAWAG, GUINOBATAN, ALBAY [1]

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In order to carry out an appropriate and effective program of rural housing improvement, a study was conducted, from December, 1949, to July, 1950, of the (a) housing conditions and problems existing in Masarawag, Guinobatan, Albay, (b) plans and types of construction, (c) relationships between house size and family size, and between income and house size, (d) different out-buildings, (e) household facilities, conveniences, and sanitation, and (f) home beautification. The data obtained were tabulated and analyzed in the Department of Agricultural Engineering.

REVIEW OF LITERATURE

Ashby (1934) recommended that a farmhouse should provide needed working areas, storage space, and living and sleeping quarters.

Carter (1936) stated that more detailed planning could give a better design for economy of space.

Wicker (1942) maintained that good construction costs more but lasts longer, depreciates slower, and reduces maintenance cost.

Sacay and Naanep (1940) reported that 83.8 per cent of the houses studied in Ilocos Norte had cogon roofs and bamboo floors and walls; 9.5 per cent had galvanized roofs and wooden walls and floors; and none had nipa roofs. The average floor area was 48.98 square meters, or 4.74 square meters for every person; the average number of rooms to a dwelling was 2.65, or 1.89 persons to a room. Of the dwellings, 64.8 per cent had three rooms; 27.7 per cent, two rooms. The average value of a dwelling was ₱136.08.

Sacay and Jarmin (1947) reported that in a farm village of Laguna, farming was the occupation of 87.8 per cent of the household heads. Of the farm operators, 17.8 per cent were owners; 50.5 per cent, part-owners; and 31.7 per cent, tenants. Of the different types of households, the husband-wife-children comprised 48.7 per cent; the husband-wife-children-relatives, 24.3 per cent. Of the houses, 73.9 per cent had cogon roofs. Houses with iron roof, bamboo walls, and bamboo floors comprised 35.6 per cent, and those with

[1] Experiment Station Contribution No. 1612. Based on the thesis presented by the junior author for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1950. Prepared in the Department of Agricultural Engineering under the direction of the senior author.

iron roof, wooden walls, and bamboo floor, 25.2 per cent. The average value of dwellings was ₱111.83. Each house had 2.5 rooms, or 0.5 room to a person. Household conveniences were meager.

Sacay, Tagorda, and Fernandez (1949) reported that owner-operators of tobacco farms in Isabela comprised 65.2 per cent; tenant-operators, 20 per cent. Of the amount invested in farms, 94.8 per cent was owned by the farm operators. The average size of farm was 5.77 hectares. The most common type of house had cogon roof, boho walls, and bamboo floor. The number of individuals in the household ranged from 2 to 12, or an average of 5.6. Modern facilities and conveniences were generally lacking.

Aglibut and Lipio (1949) reported that 20 per cent of the farm operators in Añgono, Rizal, were owners; 64 per cent, part-owners; and 16 per cent, tenants. The average size of farm was 2.54 hectares; number of rooms to a dwelling, 3.29; number of persons, 5.8; number of persons to a room, 1.76; and room for a person, 0.56. The average floor area of dwellings was 40.86 square meters; floor area of a room, 6.95 square meters; and number of persons to a sleeping room, 3.2. Eighty-nine per cent of the houses were constructed with owners' planning. Ten per cent had galvanized iron roofs, wooden walls, and wooden floors; 17 per cent, nipa or cogon roofs and nipa, cogon, bamboo or boho walls; and 73 per cent, mixed materials. Roofs of the hip-roof type were found in 94 per cent of the houses; ceilings, in only 25 houses; and concrete footings, in 25 houses. The average prewar construction cost of the dwellings was ₱435.20 and the average value was ₱808.25. The average family income was ₱1,292.25. There was generally a slight increase in house size with increase in family size, and in house size with income. Modern facilities and conveniences were generally meager in the rural homes studied, and interest in beautification of the farm homes was generally wanting. Fifty-two houses had outdoor toilets; 63 home sites were well drained; and 92 obtained drinking water from artesian wells. There were only 21 poultry houses, 10 granaries, and 3 implement sheds or rest houses.

De Leon [2] found that most of the farmers in Camiling, Tarlac, had cogon-roofed houses. Buri was generally used for walls, and bamboo, for flooring. The average floor area of a dwelling was 39.50 square meters. The owner's house was larger than that of the tenant. De Leon further stated that the average number of rooms to a dwelling was 3.38, and the average value of a house was ₱383.69.

Sacay, Kibtiani and Anuddin (1950) found that the Moro farmers in Siasi, Sulu, cultivated an average of 7.3 hectares. The

[2] De Leon, Manuel Q. A study of the economic and social conditions of rice farmers in Camiling, Tarlac. (Thesis presented for graduation from the College of Agriculture, 1939. Unpublished.)

majority of the houses had nipa roofs and bamboo walls and floors. The average family size was 6.3 persons; average floor area for a dwelling, 53.8 square meters; and average house value, ₱271.82.

Aglibut and Villa (1950) found that the average number of rooms in a dwelling in Malaking Pulo, Tanauan, Batangas, was 3.72; the average floor area, 36.50 square meters, or 9.81 square meters to a room. The average number of persons to a room was 1.24, or 0.79 room to a person; floor area to a person, 7.77 square meters; and persons to a sleeping room, 3.92. About 53 per cent of the houses were generally made of wood and bamboo; 39 per cent, of bamboo; and 8 per cent, of wood. The dwellings had an average prewar construction cost of ₱282.57 and an average value of ₱536.20 at the time the survey was conducted. Fifty per cent of the houses built between 1908 and 1941 had been repaired. The average size of a family was 4.7. House size increased with family size and family income.

MATERIALS AND METHODS

One hundred houses were visited at random in barrio Masarawag, Guinobatan, Albay. The necessary information was secured by inspection and by personal interview of the farmers, their wives, and their children. The data collected were recorded in survey sheets prepared in the Department of Agricultural Engineering.

RESULTS AND DISCUSSION

The locality: its site, physical features, population, and industries

Masarawag is 26 kilometers northwest of the city of Legaspi and 5 kilometers northeast of Guinobatan. A third-class provincial road connecting the Legaspi-Manila national road to the Ligao-Tabaco provincial road passes through the barrior proper. This road is passable throughout the year. The barrio has an approximate area of 2,000 hectares and a population of 2,195.[3] It slopes gently towards the northwestern base of Mayon Volcano, thus creating no serious drainage problem for the farmers of the locality. The soil is generally sandy loam, occasionally enriched by volcanic ash. Perennial creeks originating from the volcano and from other hills in the vicinity provide sufficient irrigation water throughout the year and enable the inhabitants to cultivate almost all the agricultural area. The deeper water table in the barrio proper necessitated the installation of 2 deep-well pumps which provide the inhabitants with drinking water.

Abacá, coconut, and rice farming are the main sources of income of the people. Corn, sweet potatoes, and other root crops are also grown as supplements to and substitutes for rice during periods of scarcity. Vegetables grow well in the place and when this study was

[3] Based on information supplied by the Bureau of Census and Statistics from the 1948 census, the report of which is still at the press.

made, the barrio was one of the best sources of vegetables for the town market.

Of the 100 families studied, 57 were engaged in full-time farming, 21 in part-time farming, and 22 were indirectly dependent on the farm for their subsistence. The 50-50 basis of sharing the produce was practiced in abacá and coconut farming; the 30-70 basis in rice farming, if the tenant shouldered all of the farm expenses and the landowner provided the seeds; and the 20-80 basis in the farming of such minor crops as corn, root crops, and vegetables.

Lumbering is also considered an important industry in the locality. Almost all of those not engaged in farming were employed either in the lumber yards or in the coco-wine distillery located near the barrio proper. Other minor sources of income of the inhabitants were merchandizing, backyard poultry and swine raising, collecting and selling rattan and "Christmas trees" (*Agathis alba*), and weaving bags and slippers.

Farm ownership. Forty-five per cent of the farmers owned their farms, 8 per cent were owner-tenants, 25 per cent were tenants, and the remaining 22 per cent had no farms.

Size of farm. The size of the farms varied from one-fourth of a hectare to 22 hectares. Forty-three families out of the 78 who were directly engaged in farming had farms with areas of 4 hectares or less. The average size of the owner-operated farms was 2.27 hectares; of the tenant farms, 2.47; and of the tenant-owner farms, 5.94. The total area of the farms was 271 hectares, or an average of 2.71 hectares to a family.

Social, educational, and economic conditions. Eighty-nine per cent of the heads of the families were born in the town of Guinobatan; 80 per cent were born in Masarawag. The bang-ga [4] system of cooperative labor was commonly used in major farm operations, construction and repair of buildings, and wedding and baptismal preparations. This system was responsible in a good measure for the mutual cooperation obtaining among the inhabitants of the village. Dances, parties, and competitive group games among the local teams and against outsiders made up most of the social activities. Cockfighting was regularly held on Sundays and on official holidays. The educational progress of the children was not overlooked by the heads of the families. To replace the schoolhouse that was destroyed in the last war, the parent-teacher association in the barrio had a temporary building constructed to house the pupils from grades one to six. Government aid and relief was generally meager.

General housing conditions

Adequacy and efficiency of the house. The dwellings were deficient in size, low in average value and in the quality of materials,

[4] The *bayani* system in the Tagalog region. The farmer employing labor under this system serves meals, drinks, and cigarettes to the workers.

and wanting in the equipment and facilities which are not uncommon in most urban homes. On the average there were 3.44 rooms or 35.76 square meters of floor area to a dwelling; 10.39 square meters to a room; 6.53 persons to a dwelling; 1.90 persons to a room or 0.53 room to a person; 3.69 persons to a sleeping room; and 5.49 square meters of floor space to a person. The houses were generally built without due consideration for future expansion.

Most of the rooms of the dwellings served more than one purpose. The living room served as bedroom even in houses where separate bedrooms were provided. In most cases, the bedroom (*sulambi* or *silid* in Tagalog), kitchen, and dining room also served as storage space. Harvested crops, tools, and equipment were stored in the ground floor of the house, which was enclosed by walls of nailed split bamboo, or *sasag*. Only one household had a separate granary. Eighty-five per cent of the houses had combination kitchen-open porches (*batalan*); 38 per cent had combination kitchen-dining rooms.

Planning. Sixty-two per cent of the houses were constructed from plans prepared by the owners; 15 per cent, from plans prepared by carpenters and other individuals. No information regarding planning was obtained from 23 house owners who succeeded to ownership through purchase or inheritance.

Aesthetics was not considered in the location of the houses, which were congregated for mutual protection and access to the supply of drinking water. Contour planning, landscaping, and modern home designing were generally lacking. It was also noted that the houses were usually built close to the roads to facilitate the transportation of farm produce.

All the houses surveyed faced the road; hence, the frontage of the dwellings depended on the directions of the road. This feature was also observed in previous similar studies conducted in other parts of the Islands. Twenty-six per cent of the houses faced northeast; 22 per cent, east; 19 per cent, southwest; 13 per cent, west; 8 per cent, north; 5 per cent, northwest; 4 per cent, south; and 3 per cent, southeast. Twenty-eight houses had their long axes along the northwest-southeast direction; 26 houses, along the east-west; 26, along the southwest-northeast; and 20, along the north-south. The average distance between houses was 13.86 meters; the farthest, about 50 meters; and the nearest, 2 meters.

Construction features and materials. The most common materials used were wood, bamboo, or a mixture of these two materials. Based on the extent (80 per cent or more) a particular material was used in a dwelling, 38 per cent of the houses were made of wood; 19 per cent, of bamboo; and 43 per cent, of wood-bamboo.

Roof. Six per cent of the houses had roofs of corrugated galvanized iron; 3 per cent, corrugated aluminum sheets; 20 per cent,

thatched dried abaca leaf sheaths; 8 per cent, cogon; and 2 per cent, thatched coconut pinnae. The roofs of the rest of the houses were combinations of two or more of these materials. Ninety-nine per cent of the houses had gable-type roofs and only one per cent had deck-type roof.

Walls. The majority of the houses studied had better materials in the house proper. Thirty-nine per cent of the houses had wooden walls in the house proper; thirty-nine per cent had wooden walls in the other parts of the dwelling. Twelve per cent had wood-bamboo walls in the main house; 45 per cent had *sasag* or *buho* walls. Fifty-seven per cent had *sasag* walls in the main room; 1 per cent had thatched coconut pinnae combined with split bamboo. One per cent had galvanized iron sheets in the other rooms. Thatched coconut leaves were also used in the house proper of two houses and in the rooms, other than the main one, of three houses.

Floor. Fifty-six per cent of the 100 houses had floors of wood; 22 per cent, wood-split bamboo; and 1 per cent each, of wood-concrete and concrete. The average height of floor from the ground was 1.10 meters.

Posts. All the houses included in this study had strong wooden posts buried deep in the ground. In four cases, the posts were strengthened above the ground with concrete and adobe block-stone masonry for greater stability during severe typhoons.

Stairs. Fifty-one per cent of the houses studied had stairs made of wood; 47 per cent, of bamboo; and 1 per cent, of concrete. Only one house did not have any stairs.

Window shutters. Forty-one per cent of the houses had window shutters made of bamboo *sasag;* 34 per cent, of wood; 9 per cent, of sash; 2 per cent, of thatched coconut pinnae; and 1 per cent each, of glass and wood-bamboo. Twelve houses did not have window shutters.

Door shutters. Fifty-two houses had doors made of wooden panels-in-frame, and 39 per cent, of *sasag.* One house had a door made of plain galvanized iron sheets, and another, of thatched coconut leaves.

Ceiling. Of the one hundred houses covered in this study, only three had ceilings made of wood. The average height of the ceiling from the floor was 2.10 meters.

Foundations. None of the houses had foundations; however, the posts in four of the houses were "packed" with concrete and adobe-stone masonry beneath the ground surface.

Construction and repair. The majority of the houses were constructed between 1935 and 1941. Forty per cent were constructed between 1938 and 1940; 15 per cent, between 1935 and 1937; and 13 per cent, in 1941. Forty-three houses had been repaired from

one to four times. Paid carpenters built 55 per cent of the 100 houses surveyed. Only 18 per cent were constructed by the owners with or without the help of neighbors who worked under the bangga system. Information on the construction of the rest of the houses was not available because the houses were either purchased or inherited by the present owners. The construction cost of the dwellings ranged from ₱70.42 to ₱1400, or an average of ₱223.55. More than 50 per cent of the dwellings were constructed at a cost of ₱200 or less.

Present value. The change in the purchasing power of money considerably increased the present value of the houses despite depreciation. The occasional additions, repairs, and improvements made on the houses further increased their present values. The values ranged from ₱75.00 to ₱3120, or an average of ₱411.35. Most of the houses were valued at ₱75.00 to ₱252.94.

Grouping of the dwellings according to roofing materials. The dwellings were divided as to whether the roofs were made of galvanized iron or aluminum sheets, nipa or anahaw, and cogon, thatched abaca leaf sheaths or coconut pinnae. Of the houses owned by farm owners, 8 belonged to the first group, 23 to the second, and 14 to the third. Of those belonging to the tenant-owners, 2 were in the first group, 4, in the second, and 2, in the third. Of the tenants' houses, 2 belonged to the first group, 7 to the second, and 16 to the third. Of the houses owned by the nonfarming individuals, 1 belonged to the first group, 13 to the second, and 8 to the third.

Grouped according to the roof of the main part of the house, 13 per cent had galvanized iron or aluminum sheet roofs; 47 per cent, anahaw or nipa roofs; and 40 per cent, cogon, abacá, or coconut roofs.

Family size and composition

Family size. The members of a family ranged from 2 to 14, or an average of 6.53 persons. Eighty-eight per cent of the families had 2 to 9 members, and 21 had 6 members. Of the household members, 28.33 per cent were parents; 66.77 per cent, children; 2.30 per cent, relatives; and 2.60 per cent, others. Of the 653 members of the families studied, 342 were females and 311 were males, or 52.37 per cent and 47.63 per cent, respectively.

Relation between family size and house size

The number of rooms in a house ranged from 1 to 8. The majority of the houses had 2 to 4 rooms. As the family increased in number, the house size increased slightly. The number of rooms, however, did not increase directly with the increase in floor area. There were cases where the houses were too small for the big families, or vice versa. An analysis of the relation between family size and number of rooms and between family size and floor area gave cor-

relation coefficients of + 0.71 and + 0.77, respectively. Both coefficients showed significance at 5 per cent level.

Family income and house size

Family income. The average annual family income, as estimated and reported to census enumerators in 1948, ranged from ₱322.76 to ₱4500.00, or an overall average of ₱945.60. Twenty-nine per cent of the families belonged to the income group of ₱151–₱470; 26 per cent, to the ₱471–₱790 group; and 21 per cent, to the ₱791–₱1110 group.

Relation between family income and house size. There was no uniform increase in either the number of rooms or the floor area as the income increased. There was, however, a correlation of + 0.28 between income and number of rooms and + 0.41 between income and floor area. These coefficients showed no significance at 5 per cent level.

Home facilities, conveniences, sanitation, and beautification

Facilities in the home. Facilities and conveniences were generally wanting in the families studied. Ninety-one per cent of the houses had wooden benches; 56 per cent, wooden chairs; 34 per cent, rattan-bamboo chairs; 34 per cent, wooden beds; 83 per cent, wooden tables; 81 per cent, flatirons; 20 per cent, table clocks; 18 per cent, foot-operated sewing machines; 15 per cent, clothes cabinets; 10 per cent, food cabinets; 9 per cent, bamboo-rattan beds; 7 per cent, rattan-bamboo chairs; and one per cent each, steel-wood chairs, army cots, and wooden shelves. The stoves used were all homemade and were built as follows: 7 per cent, of wood-earth-iron materials; 72 per cent, wood-earth-stone; 4 per cent, wood-concrete; and 17 per cent, earth-stone. There was no electric service in the barrio. All of the houses had kerosene lamps for lighting, while almost every house of the higher income group had flashlights and batteries.

Sanitation. The sanitary condition of the locality was considered poor. Twenty-four of the one hundred houses had privies of the pit-system type. Because of the absence of running water, not a single house had a water closet. Drainage was not a problem because of the porous texture of the soil and the sloping nature of the terrain. Sixty-five households obtained drinking water throughout the year from two deep-well pumps; 9, from ground wells; and 26, from ground springs. The average distance from a house to the nearest deep-well pump was 95.54 meters; to a ground spring, 94.42 meters; and to a ground well, 82.22 meters. Eighty-three houses had drinking-water containers without faucets; only 17 had containers with faucets.

Beautification. Generally, the inhabitants did not pay much attention to the beautification of their homes. Hedges served as

fences and decoration. Only 36 houses had hedges on the front boundary, twenty had hedges all around, and 17 had hedges on the side boundaries. No hedges were found around the *batalan* and outbuildings. Twenty homes had plants along the walk to the stairs; 9 had potted ornamental plants in the yard; 38 had potted plants in the house; and 27 had home gardens. None of the homes had lawns.

Different outbuildings

Very few outbuildings were found in the barrio. Three of these were hoghouses, one a poultry house, one an implement shed, and one a granary.

The hoghouse. The hoghouses were of no definite type, although the roofs were all of the shed type, made either of anahao, nipa, or thatched abacá leaf sheaths. The walls were made of unsplit bamboo, and the posts, of wood. The average floor area was 10 square meters; average cost, ₱25.00; number of pigs, 5; and distance from the house, 10 meters. Since only 3 homes had hoghouses, most of the pigs were allowed to roam around.

The implement shed. The one implement shed in the barrio was located at a distance of 1 meter from the house. It had an earth floor with an area of 30 square meters and had an average value of ₱120. The anahaw roof was of the gable type and the walls were of nailed split bamboo.

The poultry house. The poultry house had a shed-type galvanized iron roof, *sasag* bamboo walls, and wood posts. It occupied an area of 6 square meters, was valued at ₱50.00, and housed 23 birds. The majority of the families let their chickens stray during the daytime but kept them under the house or made them roost in nearby trees at night.

The granary. The granary had a floor area of 24 square meters and a value of ₱150.00. The gable-type roof was made of anahaw, and the walls were of split bamboo. The granary was located 20 meters from the dwelling.

SUMMARY

1. Of the one hundred families studied, 45 per cent were farm owner-operators; 8 per cent, part-owners; 25 per cent, tenants; and 22 per cent, without farms but indirectly dependent on farming for their living. The average size of owner-operated farms was 2.27 hectares; of partly-owned farms, 5.94 hectares; and tenant-operated farms, 2.47 hectares. The average size of a farm was 2.71 hectares.

2. The average floor area of a dwelling was 35.76 square meters; the average number of rooms, 3.44, or 0.53 room to a person; and the average floor area of a room, 10.39 square meters. The average number of persons to a room was 1.90, and to a sleeping room, 3.69.

3. Sixty-two per cent of the dwellings were built from owners' plans; 15 per cent from plans prepared by carpenters and other individuals; and 23 per cent, unknown.

4. Thirty-eight per cent of the dwellings were made of wood; 43 per cent, of wood and bamboo; and 19 per cent, of bamboo. All the houses had wooden posts; only four had concrete and adobe-stone masonry reinforcements above the ground. Ninety-nine per cent of the houses had gable-type roofs and only 1 per cent had the deck type. Twenty-one per cent had roofs made of nipa; 20 per cent, thatched abacá sheaths; 6 per cent, galvanized iron; 3 per cent, aluminum sheets; 9 per cent, anahaw; 2 per cent, thatched coconut pinnae; 8 per cent, cogon; and 31 per cent had roofs made of a combination of two or more of these materials. Grouped according to the roof of the main part of the house, 13 per cent had galvanized iron or aluminum sheet roofs; 47 per cent, anahaw or nipa roofs; and 40 per cent, cogon, abacá, or coconut roofs.

5. The dwellings had an average prewar construction cost of ₱223.55 and an average present value of ₱411.35. Eighty-eight per cent were constructed at a cost ranging from less than ₱70.42 to ₱1400; 84 per cent had present values ranging from ₱75.00 to ₱484.29.

At least 68 per cent of the houses were built between 1935 and 1941. Forty-three of the houses were repaired from one to four times.

6. The number of individuals in the family ranged from two to fourteen members, or an average of 6.53 persons to a family. Eighty-eight per cent of the families had two to nine members.

7. As the size of the family increased, the size of the house increased slightly. A positive correlation of 0.71, between family size and number of rooms, and 0.77, between family size and floor area, were obtained in this study. Both coefficients were significant at 5 per cent level.

8. The average estimated annual family income was ₱945.60. Seventy-six per cent of the families had incomes ranging from ₱322.76 to ₱993.33. A positive correlation of 0.28 existed between family income and number of rooms and 0.41 between family income and floor area.

9. Although there was no drainage problem in the locality, sanitation was considered poor on account of the absence of running water. Twenty-four houses had privies of the pit-system type. Drinking water was obtained from two deep-well pumps, from ground springs, and from ground wells not far from the dwellings.

10. Home beautification was limited to the planting of hedges on the front and side boundaries or around the house, the use of

potted ornamental plants in the house or in the yard, and the training of climbing vines along the walls of the dwelling.

11. Because there were only three hoghouses and one poultry house, stray animals roamed about the barrio. Farm produce, tools, and farm equipment were stored in the homes in the absence of granaries and implement sheds.

RECOMMENDATION

A farmhouse adapted to the locality should have:

Number of persons in the family	6 to 7
Number of rooms	5
Floor space in square meters for a person	5.48
Estimated cost	₱1,800

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INFLUENCE OF THYROPROTEIN IN RATIONS FOR GROWING AND FATTENING PIGS [1]

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Thyroprotein (protamone,[2] iodinated casein) is one of the synthetic hormones reported as affecting favorably the rate of growth of animals. As feed costs constitute about 70 to 75 per cent of the total cost of raising a market pig, the effects of the addition of thyroprotein to the College standard ration for growing and fattening pigs was studied in the Department of Animal Husbandry, College of Agriculture, from August 18, 1949, to March 16, 1950, a period of 210 days.

REVIEW OF LITERATURE

Reineke and McMillen (1946), on adding dosages of from 0.005 to 0.006 kg. iodinated casein to every 100 kg. of feed in the rations for Berkshire pigs, starting at weaning time, found a significant increase in the rate of gain and a slight increase in the efficiency of food utilization. In other experiments, Wallach, McMillen, Newland, and Reineke (1947) and Reineke, McMillen and Batzler (1948) observed that Yorkshires and Duroc Jerseys fed with 0.006 kg. of thyroprotein in every 100 kg. of feed gained 6.86 and 5.14 kg. more for every pig than their controls in a 112-day feeding trial. Berkshires fed for 14 days with 0.012 kg. of iodinated casein in every 100 kg. of feed also exceeded the gains of their controls by 12.27 kilograms for each pig. In an experiment conducted during summer, Perry, Beeson, and Andrews (1948) reported that thyroprotein, when mixed with a basal ration at levels of 0.0088 per cent, or 0.0088 kg. for every 100 kg. of feed, had no significant effect on the rate of growth or carcass characteristics, but pigs receiving 0.0132 kg. of thyroprotein with every 100 kg. of feed gained 6.36 kg. more and required the same amount of feed for each unit gain as their controls. Hogs receiving higher levels of thyroprotein had significantly longer carcasses and heavier loins than the controls. They also reported that in a winter trial, thyroprotein mixed at levels of 0.0088, 0.0132, and 0.0176 kg. with 100 kg. of feed produced hogs that were 4.55, 7.73, and 12.27 kg. heavier than the control group after 95 days of feeding.

On the other hand, Vander Noot, Reece, and Skelly (1949) reported that daily feeding of either 0.075 or 0.15 gram of thyro-

[1] Experiment Station Contribution No. 1613. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, October, 1950. Prepared in the Department of Animal Husbandry under the direction of Dr. Mariano Mondoñedo.

[2] Protamone is a commercial product of the Cerophyl Laboratories, Inc., Kansas City, Mo. It is a compound of casein and iodine with thyroid-like properties. The protamone used in this experiment was kindly supplied by the Cerophyl Laboratories, Inc.

protein to 100 lb. (45.36 kg.) of live weight had no influence on gains in body weight and on the amount of feed consumed for every 100 lb. of gain. They were also of the opinion that adding 0.225 gram of thyroprotein to the feed did not influence gains in weight but increased the amount of feed consumed for every 100 lb. of gain. The addition to the feed of higher levels of thyroprotein, 0.5, 1.0, 2.0, and 4.0 grams for every 100 lb. of live weight, decreased the gains in weight and increased the amount of feed consumed for every 100 lb. of gain in weight. Blaxter, Reineke, Crampton, and Peterson (1949) cited Braude (1947) as reporting that the addition of thyroprotein in dosages lower than 1.5 grams daily produced no significant acceleration of growth.

MATERIALS AND METHODS

Twenty Berkjala weanling barrows, approximately six months old, were used in a 210-day feeding test, divided into three periods.

The College standard ration for swine was used. Thyroprotein was added to the rations of lots 2, 3, and 4 as follows:

GROWTH PERIOD

CONSTITUENTS OF RATION	LOT 1	LOT 2	LOT 3	LOT 4
		kilograms		
Corn	15	15	15	15
Fine rice bran	60	60	60	60
Copra meal	18	18	18	18
Fish meal	7	7	7	7
Total	100	100	100	100
Thyroprotein added	0	0.005	0.010	0.015

GROWTH AND FATTENING PERIOD

CONSTITUENTS OF RATION	LOT 1	LOT 2	LOT 3	LOT 4
		kilograms		
Corn	20	20	20	20
Fine rice bran	60	60	60	60
Copra meal	16	16	16	16
Fish meal	4	4	4	4
Total	100	100	100	100
Thyroprotein added	0	0.005	0.010	0.015

FATTENING PERIOD

CONSTITUENTS OF RATION	LOT 1	LOT 2	LOT 3	LOT 4
		kilograms		
Corn	25	25	25	25
Fine rice bran	60	60	60	60
Copra meal	12	12	12	12
Fish meal	3	3	3	3
Total	100	100	100	100
Thyroprotein added	0	0.005	0.010	0.015

For every 100 kg. of concentrate ration, one kg. of common table salt was added.

Four lots of five pigs each, of uniform size, weight, and age were used in the test.

The pigs were hand-fed twice a day, between 5:00 and 6:00 a.m. and between 5:00 and 6:00 p.m. They were allowed to eat as much as they could. Soilage, at the rate of 0.5 kg. of camote vines for every 100 kg. of live weight, was given daily during the first period and once or twice a week during the second and third periods. For the duration of the experiment, the pigs were fed in the hoghouse. They were driven into separate runs bare of vegetation after feeding, except in inclement weather when they were kept in the hoghouse.

The animals were weighed every week throughout the experiment. They were bathed and allowed to dry off before they were weighed. Their initial and final weights were averages of two consecutive weighings.

RESULTS AND DISCUSSION

In discussing the results of adding thyroprotein at various levels to concentrate rations, the rations of lots 1, 2, 3, and 4 will be referred to as 0-, 5-, 10-, and 15-gram thyroprotein rations, respectively. These results were based on the following factors: (1) daily rate of gain; (2) amount of feed, in kilograms, to produce a kilogram of gain; and (3) cost of feed, in pesos,[3] to produce a kilogram of gain. The 0-protamone rations, the control, was used as the basis for comparison.

The first 70-day period or the growing period. As regards rate of gain, the 15-gram thyroprotein ration gave the best results; the 10-gram thyroprotein ration came second; the 0-thyroprotein ration, third; and the 5-gram thyroprotein ration, last. The differences in efficiency were slight, ranging from 92 per cent for the 5-gram protamone level to 106 per cent for the 15-gram thyroprotein level.

From the point of view of feed utilization, or the amount of feed required for a given unit of gain, the 0-thyroprotein ration was the most economical; the 15-gram thyroprotein ration, second; the 10-gram thyroprotein ration, third; and the 5-gram thyroprotein ration, last. Expressed in percentage, these differences in efficiency were 100, 95.20, 94.95 and 93.09 per cent, respectively. The feed cost for every kilogram of gain was ₱0.85, ₱0.86, ₱0.88, and ₱0.91, respectively. Based on the 100 per cent efficiency of the 0-thyroprotein ration, the efficiency of the 5-gram thyroprotein ration was 92.94 per cent; the 10-gram thyroprotein ration, 94.94 per cent; and the 15-gram thyroprotein ration, 100.12 per cent. The differences were small.

[3] The cost of the protamone was not included in the cost of feed to produce one kilogram of gain, as the product was supplied without cost by the Cerophyl Laboratories, Inc. Furthermore, the amount of protamone used was so small that its cost would not have materially affected the results.

Second 70-day period or the growth-fattening period. In rate of gain, feed utilization, and cost of feed to produce a kilogram gain, lot 3 on the 10-gram thyroprotein ration gave the best results; lot 4 on the 15-gram thyroprotein ration came second; lot 2 on the 5-gram thyroprotein ration, third; and lot 1 on the 0-thyroprotein ration, last. It appeared that in this period or age-weight of the pigs, the optimum level lay somewhere between the 10- and 15-gram thyroprotein levels. The 15-gram protamone level appeared too much, while the 5-gram protamone level appeared too small. Based on the rapidity of gain, feed utilization, and cost of feed, the differences were consistent throughout and substantial, although small. Compared to the 0-thyroprotein ration, the 10-gram thyroprotein ration was more efficient by 8.84 per cent; the 15-gram thyroprotein ration, by 4 per cent; and the 5-gram thyroprotein ration, by 3 per cent.

Third 70-day period or the fattening period. In this period, a marked increase in the rate of gain of lots 3 and 4 was noted. Lot 3 on the 10-gram thyroprotein ration made a gain of 0.425 kg.; lot 4 on the 15-gram thyroprotein ration, 0.321 kg. Lot 1 on the 0-thyroprotein ration made an average daily gain of 0.23 kg.; lot 2 on the 5-gram thyroprotein ration, 0.22 kg. The pigs in lots 3 and 4 were 83.19 per cent and 38.36 per cent heavier, respectively, than those in lot 1. The increase in the rate of gain of the pigs in lots 3 and 4 was accompanied by an improvement in the consumption and utilization of feeds for larger gains in weight. It appeared that the addition of 10 grams of thyroprotein to every 100 kg. of concentrate mixture improved the nutritional quality of the ration of lot 3. The differences in the rate of gain were insignificant.

The entire 210-day test. In the entire 210-day feeding trial, the differences were insignificant. The animals were in good condition, although those in lots 3 and 4 were more uniform in size and weight than those in lots 1 and 2. One pig in lot 1 died on February 16, 1950, of hemorrhagic septicemia. In the first 70-day feeding period, some pigs in lots 3 and 4 appeared sick, but these recovered and made gains in weight up to the end of the experiment.

SUMMARY

The addition of 5, 10, and 15 grams of thyroprotein to every 100 kg. of the ration for growing and fattening pigs did not have any influence on the rate of gain. The addition of 10 and 15 grams of thyroprotein, however, reduced the amount and cost of feed necessary to make a kilogram of gain. This result was more marked in the subsequent feeding periods.

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THE CATTLE AND CARABAOS IN LOS BAÑOS, CALAMBA, AND CABUYAO, LAGUNA, AFTER THE LIBERATION OF THE PHILIPPINES IN 1945 [1]

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Cattle and carabaos are sources of power and of meat. Many of these animals were slaughtered for food during the Japanese occupation and the liberation of the Philippines. In order to have a basis for judging the postwar recovery of the Philippine animal industry, a study was made from August, 1945, to August, 1946, of the cattle and carabaos in Los Baños, Calamba, and Cabuyao, Laguna, which survived the ravages of war. In this study were determined (a) the age, sex, height, heart girth, length of tail, defects, and color of the animals; (b) the number of carabaos and cattle used for breeding, for work, and for meat; and (c) the purchase prices of said livestock at the time of the study.

According to the census of the Philippines for 1939, Los Baños had 253 cattle and 635 carabaos; Calamba, 878 cattle and 3,404 carabaos; and Cabuyao, 317 cattle and 1,511 carabaos.

Previous work on cattle and carabao

Evaristo (1915) stated that a good specimen of the Philippine carabao shoud be 162.6 cm. high at the withers and 238.8 cm. at the heart girth. At that time, the average price of the carabaos bought from Indo-China was ₱125.

In 1927, Villegas and Sarao stated that the five-year-old grade Nellore in the Hacienda del Rosario in Cainta, Rizal, had an average height of 100.7 cm., and the medium-aged and old animals, 110.0 cm. Black was the predominating color in the herd, with red ranking second. Villegas, in 1932, observed that the average height of carabaos in Los Baños was 129.8 cm. He further observed that the mean height of carabaos in Bay, Calauan, and Pila was 127.25 $\mp$ 0.17 cm., and the heart girth, 195.70 $\mp$ 0.90 cm.

Boncales noted a carabao with a white switch in 1951. He found that the mean height of mature cattle in Bay, Calauan, and Pila, Laguna was 119.39 $\mp$ 2.01 cm., and the heart girth, 164.54 $\mp$ 3.08 cm.

How the study was made

A total of 157 cattle and 370 carabaos were observed. The cattle consisted of 147 Natives, 3 Nellores, 2 Red Sindhis, 2 Red Sindhi $\times$

[1] Experiment Station Contribution No. 1614. Thesis presented for graduation with the degree of Bachelor of Science in Agriculture from the College of Agriculture, November, 1946. Prepared in the Department of Animal Husbandry under the direction of Professor Valente Villegas.

Native, and 3 Philamins; the carabaos consisted of 334 Natives, 2 Murrahs, and 34 Grade Murrahs. Forty-eight native cattle, 3 Nellores, 2 Red Sindhis, 2 Red Sindhi × Native, 3 Philamins, 102 native carabaos, 2 Murrahs, and 33 Grade Murrahs were in Los Baños; 53 native cattle, 116 native carabaos, and 1 castrated Grade Murrah in Calamba; and 46 native cattle and 116 native carabaos in Cabuyao.

The data on blood composition, capacity for work, feed consumption, and management of the animals were collected through weekly inspections and interviews of the owners. During these visits the defects of the animals were also noted and their color and sex determined. The ages of the animals were determined from the eruption of the temporary and permanent incisors in the lower jaws of those below five years of age, from the wear of the incisors in the mature ones, and from certificates of ownership and birth records.

The heights, heart girths, and lengths of tail of 53 native cattle and 164 native carabaos of five years or more of age were recorded. The height of the animal standing squarely on level ground was taken by placing the calibrated wooden stick just behind the shoulder perpendicular to the ground. The heart girth was taken by encircling the thoracic region just behind the foreflank with a measuring tape. Because of the belief that the tail reaching below the hock indicates endurance, the tails of mature work cattle and carabaos were measured from the base to the tip. The length of the tail affected the price of the work animal.

The number of animals slaughtered from August, 1945, to August, 1946, was taken from the records of the office of the municipal treasurer of each town.

RESULTS

Blood composition of the animals

The classification of the cattle and carabaos according to their blood composition is shown below:

BLOOD COMPOSITION	NUMBER OF ANIMALS	PER CENT
Cattle:		
Native	147	93.63
Nellore	3	1.91
Red Sindhi	2	1.27
Red Sindhi × Native	2	1.273
Philamin	3	1.273
Total	157	99.996
Carabaos:		
Native	334	90.27
Murrah	2	0.54
Grade Murrah	34	9.19
Total	370	100.00

Age, sex, and color

The native cattle and carabaos ranged in age from 1 to 25 years, or a mean of 4.48 ∓ 0.27 years and 5.67 ∓ 0.24 years, respectively.

The native cattle in Los Baños consisted of 23 males, five of which were castrated, and 25 females. The sex ratio was 47.9 per cent. The male and female carabaos were even in number, but 3 of the males were castrated. In Calamba, the native cattle consisted of 31 males, six of which were castrated, and 22 females, or a sex ratio of 58.5 per cent. There were 66 male and 50 female carabaos, or a sex ratio of 56.9 per cent. Eighteen of the native cattle in Cabuyao were males and 28 were females, or a sex ratio of 39.1 per cent. There were 59 male carabaos, one of which was castrated, and 57 females, or a sex ratio of 50.86 per cent.

Except for four albinos, all the native carabaos in the three towns were light black. Six colors were noted among the native cattle. Dun or fawn predominated with a percentage of 57.1. Twenty-three, or 15.6 per cent, were of mixed colors; 12, or 8.1 per cent, were red; 10, or 6.8 per cent, cream; 9, or 6.1 per cent, black; and 9, or 6.1 per cent, yellow.

Body Measurements

The means in centimeters of the body measurements of the mature animals were as follows:

CATTLE

Height at withers, both sexes	118.06 ∓ 1.05
Height at withers, male	122.89 ∓ 0.94
Height at withers, female	113.04 ∓ 1.31
Height at withers, castrated	125.56 ∓ 1.66
Heart girth, both sexes	169.90 ∓ 2.16
Heart girth, male	177.76 ∓ 1.74
Heart girth, female	161.23 ∓ 2.99
Heart girth, castrated	182.83 ∓ 4.14
Length of tail, both sexes	77.85 ∓ 1.48

CARABAOS

Height at withers, both sexes	128.49 ∓ 0.37
Height at withers, male	129.66 ∓ 0.44
Height at withers, female	126.93 ∓ 0.61
Height at withers, castrated	134.14 ∓ 1.82
Heart girth, both sexes	198.60 ∓ 0.81
Heart girth, male	201.36 ∓ 1.00
Heart girth, female	193.54 ∓ 1.20
Heart girth, castrated	207.29 ∓ 4.56
Length of tail, both sexes	77.08 ∓ 0.57

Number and percentage of animals with defects in conformation, unsoundnesses, and blemishes

CATTLE

Upstanding conformation of body	7	4.76
Short and drooping rump	5	3.40
Sway-back	5	3.40
Lame right foreleg	1	0.68
Torn nasal septum	1	0.68
Broken right horn	1	0.68
Broken left horn	3	2.04

	CARABAOS	
Short and drooping rump	8	2.40
Upstanding body	8	2.40
Sway-back	7	2.10
Splayfoot	6	1.80
Torn nasal septum	2	0.60
Blind right eye	1	0.30
Blind left eye	1	0.30
Lame left hind leg	1	0.30

Animals for breeding purposes, for work, and for meat

Eighty-three of the native cattle studied, of which 38, or 25.8 per cent, were males and 45, or 30.6 per cent, females, were breeding stock. Of the 334 native carabaos, 236, or 70.6 per cent, were for breeding. Of these, 116, or 34.7 per cent, were males and 120, or 35.9 per cent, females. Almost all the animals for breeding were also used for work under upland and lowland conditions.

Among the native cattle only 17, or 11.7 per cent, were work animals. Fourteen of the work cattle, or 82.3 per cent, were for plowing upland areas; 3, or 17.6 per cent, for pulling carretons. As Calamba, Cabuyao, and Los Baños are rice-producing towns, 266, or 79.6 per cent of all the carabaos were used for work. Two hundred forty-eight, or 93.2 per cent, were used for plowing upland and lowland areas; 18, or 6.7 per cent, for carting purposes. All castrated males were used as work animals.

From August, 1945, to August, 1946, 279 native cattle were slaughtered as follows: 128 head of cattle in Calamba, 88 in Cabuyao, and 63 in Los Baños. During that period, lean meat of cattle cost ₱4.00 a kilo in Calamba and Cabuyao and ₱3.50 in Los Baños; lean meat and bone cost ₱3.00 in Los Baños and Calamba and ₱3.50 in Cabuyao. Calamba slaughtered 15 carabaos, Cabuyao, 11, and Los Baños, 2. The price of lean meat of carabaos in Los Baños, Calamba, and Cabuyao was ₱2.50 a kilo; that of lean meat and bone, ₱2.00 a kilo. The high price of meat was due to the scarcity of supply.

Purchase prices

The average price of native cattle for beef was ₱171.40 and for breeding stock, ₱500. Only one work ox was sold at ₱350. Eleven carabaos for plowing upland and lowland areas were sold at prices ranging from ₱250 to ₱800, or an average of ₱435.91.

The condition and management of the native cattle and carabaos in the three towns

The condition or degree of fatness of the cattle and carabaos in Los Baños, Calamba, and Cabuyao and the number and percentage of the animals in each group were as follows:

	CATTLE		CARABAOS	
	Los Baños			
Thin	8	16.67	5	4.90
Medium	27	56.25	44	43.14
Fat	13	27.08	53	51.96
Total	48	100.00	102	100.00

	Calamba			
Thin	3	5.66	5	4.31
Medium	31	58.49	69	59.48
Fat	19	35.85	42	36.21
Total	53	100.00	116	100.00
	Cabuyao			
Thin	3	6.52	4	3.45
Medium	28	60.87	75	64.65
Fat	15	32.61	37	31.90
Total	46	100.00	116	100.00

As regards feeding and management, the general practice in the three towns was to turn the animals loose in the rice fields and neglected areas after the harvest season. At night the animals were tied to stakes and a bundle of green feed, about 50 cm. in diameter, given to each. During the planting season, the animals were tied to stakes and allowed to graze over an area with a radius of 8 to 12 meters. They were led to a creek or to the shade of a tree during the hot hours of the day. At night the animals were tied near rice-straw stacks on which they fed. After the planting season, they were pastured in the fields and cared for by boys who rode on the backs of the grazing animals.

Foreign breeds

The foreign breed of cattle studied was the Nellore breed in the College, three of which survived the war. The Murrah breed is the foreign breed of carabaos most adapted to Philippine conditions. Only 2 of them and 34 grades survived the war.

The College saved 5 (4 females and 1 male) half-blooded Murrahs. No. 1 was born on January 15, 1926; No. 2, on October 14, 1927; and No. 4, on November 10, 1930. No. 5, the youngest of the four dairy animals, was born on July 17, 1932; No. 3, the only male, but castrated, was born on April 26, 1931.

The mean weight, height, and heart girth of three of the four female half-blooded Murrahs were 607.25 $\mp$ 40.63 kg., 133 $\mp$ 1.12 cm., and 206.75 $\mp$ 2.70 cm., respectively. No. 4 was the heaviest and had the largest heart girth, although it was second to the shortest. No. 5 was the lightest, had the smallest heart girth, and was the shortest of the five animals. No. 3 was 137 cm. high, the tallest of all.

Ten selected native male cattle

The College acquired ten selected native male cattle for rehabilitating its stock. The mean weight, height, and heart girth of these animals were 406.56 $\mp$ 12.98 kg., 127.7 $\mp$ 0.44 cm., and 183.5 $\mp$ 3.54 cm., respectively. They were of three colors: red, brown, and dark brown. Three were dark brown and two were brown. Among the five red cattle, one had white patches at the hind extremity.

SUMMARY

1. The 157 head of cattle studied consisted of 147 Natives, 3 Nellores, 2 Red Sindhis, 2 Red Sindhi × Native, and 3 Philamins; the 370 carabaos, of 334 native carabaos, 2 Murrahs, and 34 Grade Murrahs. The native cattle were dun or fawn, yellow, red, cream, black, or of mixed colors; the native carabaos were all light black, except for 4 albinos. The native cattle ranged from 1 to 25 years of age, or a mean of 4.48 ∓ 0.27 years and a mode of 2 years. The native carabaos also ranged from 1 to 25 years, or a mean of 5.67 ∓ 0.24 years and a mode of 3 years. The sex ratio of the native cattle was 48.9 per cent; that of the carabaos, 52.7 per cent.

2. The mean height of the mature native cattle of both sexes was 118.06 ∓ 1.05 cm., and that of the mature native carabaos, also of both sexes, 128.49 ∓ 0.37 cm. The mature castrated carabaos had a slightly higher mean, 134.14 ∓ 1.82 cm. The mean heart girth of mature native cattle of both sexes was 169.90 ∓ 2.16 cm., and that of native mature carabaos, also of both sexes, was 198.60 ∓ 0.81 cm. The mean length of tail of the native cattle was 77.85 ∓ 1.48, and that of the native carabaos, 77.08 ∓ 0.57 cm. Forty-five of the mature native cattle and 114 of the mature native carabaos had tails extending beyond their hocks.

3. Upstanding conformation of the body, short and drooping rump, sway-back, lame right foreleg, torn nasal septum, and broken horn were common among the native cattle and carabaos. Short and drooping rump, upstanding body, sway-back, splayfoot, torn nasal septum, blind eye, and lame hind leg were frequent among the carabaos.

4. Thirty-eight head, or 25.8 per cent of the male native cattle, and 45 head, or 30.6 per cent of the female, were for breeding purposes; 116 head, or 34.7 per cent of the male carabaos, and 120 head, or 35.9 per cent, were also for breeding. The work cattle were for carting and plowing upland areas, the work carabaos, for plowing upland and lowland fields.

5. Two hundred seventy-nine native cattle slaughtered from August, 1945, to August, 1946, retailed at ₱3.50 a kilo of lean meat in Los Baños and ₱4.00 in Calamba and Cabuyao. A kilo of lean meat and bone was ₱3.00 in Los Baños and Calamba and ₱3.50 in Cabuyao. The 28 native carabaos slaughtered retailed at ₱2.50 a kilo of lean meat and ₱2.00 a kilo of lean meat and bone. Native cattle for beef was sold at an average of ₱171.40 each and those for breeding, ₱500.00. The native work carabaos sold for ₱435.91 each.

6. The native cattle and carabaos were, in general, medium in condition or degree of fatness.

7. The animals were turned loose in the rice fields and neglected areas after harvest, but at planting time they were grazed in a limited area.

8. To the College foreign breeds of cattle and carabaos, consisting of 3 Nellores, 2 Red Sindhis, 2 Red Sindhi × Native, 3 Philamins, 2 Murrah carabaos, 5 half-blooded Murrahs, and 29 Grade Murrahs, 10 selected, mature, native male cattle were added to rehabilitate the stock.

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COLLEGE AND ALUMNI NOTES

Dr. Vidal A. Tan, president of the University of the Philippines, made his first official visit to the College on August 13, 1951. In a special convocation, he discussed the role of the College of Agriculture in promoting the economic progress of the country. He was guest at a luncheon given in his honor by the members of the faculty and the employees.

Miss Elsa B. Lapuz, recently appointed assistant instructor in the Rural High School, reported for duty on August 14, 1951. She is a holder of the B.S.E. degree, major in Tagalog, from the University of the Philippines.

A regular scientific meeting of the Los Baños Biological Club was held on August 31, 1951, at the Agricultural Chemistry Lecture Hall. The following papers were read and discussed: "Readings of body temperatures of farm animals at two-minute and three-minute intervals," by Valente Villegas of the Department of Animal Husbandry and "Equity of the share lease used among rice farmers in Calamba, Laguna," by F. M. Sacay and E. P. Agustin of the Departments of Agricultural Education and Agricultural Economics.

Mrs. Obdulia Fronda-Sison, '46, instructor in the Department of Agricultural Education, was recently designated supervisor of women students, following the resignation from that position of Mrs. Juana P. Gapud, instructor in the same department.

Mr. Jesus P. Mamisao, '30, of the Bureau of Soil Survey and Conservation, sailed for the United States on August 26, 1951. He was granted a scholarship under the Fulbright and the Smith-Mundt Acts.

The Section on Cane Diseases of the Seventh Congress of the International Society of Sugar Cane Technologists held in Brisbane, Queensland, Australia, adopted a resolution on September 15, 1950, appointing the members of the standing committee for the purpose of maintaining a current listing of all cane diseases of the world, reported upon at each future Congress. The following were appointed to serve on this Committee: C. G. Hughes (Australia), T. T. Lo (Formosa), J. B. Martin, Chairman (Hawaii), E. B. Martyn (Jamaica), J. W. Hes (Java), G. Orian (Mauritius), G. O. Ocfemia (Philippines), L. A. Alvarez Garcia (Puerto Rico), A. McMartin (South Africa), and E. V. Abbot (United States).

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